SELECTED

ESOURCESABSTRACTS



YOLUME 3, NUMBER 10MAY 15, 1970

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SELECTED

WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center, Office of Water Resources Research, U.S. Department of the Interior

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VOLUME 3, NUMBER 10MAY 15, 1970

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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the Water Resources Thesaurus (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University
 of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

CONTENTS

FOREWORD	.iii
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SUBJECT FIELDS AND GROUPS

(Use Edge Index on back cover to Locate Subject Fields and Indexes in the journal.)

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Non-Water Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

02. WATER CYCLE

2A. General

CONTRIBUTION OF ISOTOPE TECHNIQUES TO THE STUDY OF SOME HYDROLOGICAL PROBLEMS,
International Atomic Energy Agency, Vienna

(Austria)

Bryan R. Payne.

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 62-68, 1967. 7 p, 4 fig.

Descriptors: *Radioisotopes, *Radioactivity techniques, *Tritium, *Deuterium, Precipitation (Atmospheric), Lakes, Hydrogeology, Groundwater recharge, Groundwater movement, Surveys. Identifiers: Turkey, Kenya, Jamaica, Austria, International Atomic Energy Agency.

Some of the hydrogen and oxygen isotope studies in hydrology in which the International Atomic Energy Agency is currently engaged in Turkey, Kenya, Jamaica and Austria are outlined. Variations in concentration of tritium, deuterium and oxygen 18 were measured in precipitation, lakes, and groundwater in different regions and the results have been applied to the solution of some hydrological problems including the turnover time of lakes, the interconnections between different water bodies, location of recharge areas, and the transient times since recharge. Isotope techniques can provide useful information for a better understanding of hydrological and hydrogeological problems. (Carstea-USGS) W70-03694

A NUMERICAL MODEL FOR THE HYDROLOGIC TRANSPORT OF RADIOACTIVE AEROSOLS FROM PRECIPITATION TO

WATER SUPPLIES,
Stanford Univ., Calif. Dept. of Civil Engineering.
Dale D. Huff, and Paul Kruger.

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 85-96, 1967. 12 p, 4 fig, 2 tab, 22 ref. USPHS Res Grant ES-00047-01.

Descriptors: *Radioactivity techniques, *Mathematical models, *Aersols, *Hydrologic cycle, *Path of pollutants, Precipitation (Atmospheric), Water supply, Radioisotopes, Runoff, Watersheds (Basins), Hydrographs, Rainfall-runoff relationships, Numerical analysis.

Identifiers: *Radioactive aerosols.

Preparation is underway of a numerical model of the transport of nuclear debris from the at-mosphere by precipitation through the surface-water portion of the hydrologic cycle. The model collates the significant parameters involved, such as the physical and chemical properties of biologias the physical and chemical properties of biologi-cally important radionuclides in aerosols, their deposition by precipitation under Pacific coast cyclonic conditions, and their movement through the catchment basin during precipitation and ru-noff. The model is based upon the quantitative estimation of these parameters under conditions given by an existing computer model which traces the movement of water through the basin to predict the runoff hydrograph. The numerical model should serve as an index of predictability for radionuclide concentration in water supplies originating from atmospheric sources and as a means to locate areas where additional numerical knowledge of hydrologic processes is needed. (Carstea-USGS) W70-03698

A MOSAIC TECHNIQUE FOR GENERATING THE DAILY PATTERN WITHIN A SYNTHETIC FLOW SEQUENCE, Welsh Coll. of Advanced Technology, Cardiff; and Water Research Association, Medmenham (En-

gland). G. J. Cockell, and J. A. Cole.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 36, p 277-282, 1967. 6 p, 1 tab, 4 ref, append.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, *Synthetic hydrology, *Probability, Markov processes, Hydrologic data, Unit hydrographs, Streamflow forecasting, Runoff forecasting, Discharge (Water), Computer programs. Identifiers: Watershed models.

A realistic pattern of daily flows may be required for a month, in which the total flow has been synthetically determined by a Markov chain model. The mosaic technique does this by selecting specimen months from historical daily rainfall or river discharge records, giving the required total monthly runoff. By having two sets of specimen months, wit higher and lower than average runoff at the start of the month, juxtaposition of unduly disparate flows at the transition from one month to the next may be avoided. The technique is illus-trated with the use of 40 specimen months of rain-fall record in a river's headwaters. Seasonal runoff upon rainfall regression effect the conversion to daily available flows. They are then transformed by unit hydrographs to give the allocation of daily flows of the river and its tributaries at various downstream sites. An appendix details the computer program in Algol which operates the mosaic technique. (Knapp-USGS)
W70-03704

ON THE FLUCTUATION OF WATER

RESOURCES, Kyoto Univ. (Japan). Disasters Prevention Research Inst.

Masami Sugawara.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 45, p 344-353, 1967. 10 p, 5 fig, 1 tab, 1 ref.

Descriptors: *Streamflow forecasting, *Reservoir operation, *Statistical methods, *Time series analysis, *Water management (Applied), Fourier analysis, Frequency analysis, Statistical models, Reservoir yield.

Identifiers: *Spectral analysis.

Hydrological data such as river discharge, precipitation, etc., show large fluctuation with time, while demand on water is approximately constant with time. To take the constant demand out of the fluctuating supply, we construct reservoirs. Draft-storage relations must depend on the fluctuations of supply. Moreover, they must depend on the spectral structure of the supply, regarded as time series. If the supply fluctuates mainly in high frequency regions, it may be smoothened by small reservoirs, but if the supply has a long period on the order of years, it is very difficult to smooth fluctuations. From this standpoint a spectral analysis of hydrological data was made using mainly monthly precipitation. Contrary to expectation, no significant cycle, except seasonal change, could be found. From an analysis of monthly precipitation of about a century, we conclude that this time series is a composition of seasonal pattern and random noise. ne time series of this type is not suitable for mathematical analysis, a numerical method is used to find the relation between the capacity of reservoir and the amount of water demand. (Knapp-USGS) W70-03705

STOCHASTIC ASPECTS OF RESERVOIR STORAGE, Manchester Univ. (England). Inst of Science and

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 46, p 354-360, 1967. 7 p, 16 ref. Descriptors: *Streamflow forecasting, *Reservoir operation, *Statistical methods, *Water management (Applied), *Stochastic processes, Markov processes, Statistical models, Mathematical models, Synthetic hydrology, Reservoir yield, Probability. Identifiers: Reservoir storage models.

The application of stochastic theory to reservoir storage processes (the Markov chain concept) has enabled these processes to be accurately described. An account of the findings is given. Earlier methods are then reviewed and it is shown that they are unsound in principle because either finite capacity of reservoir is ignored or annual and seasonal depletions are treated separately. Nevertheless comparison with the new approach suggests that the earlier methods may give accepta-ble results in cases where the probability of empty-ing is low. (Knapp-USGS) W70-03706

CYCLIC FLUCTUATIONS OF VARIABILITY IN HYDROLOGIC PHENOMENA,

Water Conservancy Board, zechoslovakia). Prague

Oldrich Vitha, and Vladmir Soucek.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 51, p 389-396, 1967. 8 p, 5 fig, 2 tab, 3 ref.

Descriptors: *Streamflow forecasting, *Rainfall-ruoff relationships, *Statistical methods, Stochastic processes, Time series analysis, Frequency analysis, Runoff forecasting, Reservoir operation, Reservoir yield, Water management (Applied). Identifiers: Watershed models.

Investigations are made of the dependence of basic statistical parameters expressing the regime of long-term variations of runoff and precipitation series. Mathematical tests show that the mean cycle of sunspots influences the distribution, and the variability of runoff and precipitation series. Relations are verified by comparing the results from real and random artificially established runoff series. A scheme of practical use is given with an example of the calculation of the effect of a reservoir with multiyear outflow control. (Knapp-USGS) W70-03711 variability of runoff and precipitation series. Rela-

SUNSPOTS AND HYDROLOGIC TIME SERIES. Colorado State Univ., Fort Collins. Dept. of Civil

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Ignacio Rodriquez, and Vujica Yevjevich.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 52, p 397-405, 1967. 9 p, 6 fig, 1 tab, 4 ref. NSF Grant GK-169.

Descriptors: *Hydrologic cycle, *Time series analysis, *Precipitatior (Atmospheric), *Runoff, Correlation analysis, Streamflow, Frequency analysis, Statistical methods, Rainfall disposition.
Identifiers: *Hydrologic time series, *Sunspots.

The relationship of hydrologic series of monthly precipitation, annual precipitation and annual ruoff to sunspot numbers was investigated by cross-correlation analysis for various time lags (zero lag included) and by cross-spectral analysis. A total of 88 series of monthly precipitation and 174 series of annual precipitation (stations from Western United States), and 16 series of annual flows (stations from several parts of the world) were used as research data. No significant correlation was found between these hydrologic series and sunspot numbers. In fact, the spectrum of sunspot numbers proved to be nearly identical to the spectrum of residuals, when the values of hydrologic series were deduced from the values of sunspot series in order to obtain residuals. The coherence graphs worked out are within confidence limits that indicate there are no relationships between hydrologic series and sun-spot numbers. Sampling fluctuations of cross-cor-relation coefficients between hydrologic series and

Group 2A-General

sunspot numbers increase when both series are smoothed by moving average schemes. Therefore, when the confidence limits of unsmoothed series are used in the smoothed series approach, incorrect conclusions may be drawn about the significance of correlations. (Knapp-USGS) W70-03712

APPLICATIONS OF MONTE CARLO METHOD

TO RESERVOIR DESIGN,
Institute of Water Resources Research, Berlin

(East Germany). Siegfried Dyck, and Michael Schramm. French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 53, p 406-413, 1967. 8 p, 5 fig, 1 tab, 5 ref.

Descriptors: *Reservoir design, *Streamflow forecasting, *Time series analysis, *Reservoir yield, Reservoir operation, Water management (Applied), Statistical methods, Runoff forecasting. Identifiers: Watershed models.

In applying the Monte Carlo Method to reservoir design long time series of discharge may be generated, using the method proposed by Svanidze. First, two arrangements for the correlation function are considered. Then the serial correlation coefficient between yearly river flows are calculated. To examine the connection between annual river flow and subannual changes of flow for the observed station the range of the residual mass curve of monthly flows is used. When generating time series according to the used method, negative river flows are sometimes obtained. (Knapp-USGS) W70-03713

SECTION I, INTRODUCTION; SECTION II, DETERMINATION OF DESIGN DISCHARGE;

SECTION IX, APPENDIX. Knowlton-Ratliff-English, Fort Worth, Tex. For primary bibliographic entry see Field 08A. W70-03815

THE EFFECT OF SOIL MOISTURE ON INFIL-TRATION AS RELATED TO RUNOFF AND

Saskatchewan Univ., Saskatoon. Dept. of Agricul-

tural Engineering.
For primary bibliographic entry see Field 02G.
W70-03884

ERRORS IN DISCHARGE ESTIMATES ON

MOUNTAIN STREAMS,
Ontario Agricultural Coll., Guelph. School of
Agricultural Engineering.
W. T. Dickinson.

French resume included. Proceedings of Internarenear resume included. Proceedings of interna-tional Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 71, p 573-580, 1967. 8 p, 2 tab, 4 ref. Bureau of Reclamation Contract No 14-06-D-5299.

Descriptors: *Streamflow forecasting, *Rainfall-runeff relationships, Data processing, Stainfall-runoff relationships, Data processing, Statistical methods, Evaluation, Stage-discharge relations, Discharge measurement, Estimating, Least squares method, Regression analysis.

Identifiers: Error analysis.

A mathematical representation is given to the stage-discharge relationship, and found to account for virtually all of the variability in sample data for 9 mountain stream-gaging stations in Colorado. The concept of a divisive discharge value is introduced to separate the rating curve into 2 portions; one along which the relative error is practically constant and the relative error is practically constant and the relative error is practically constant and the relative error is practically constant. cally constant; and the other along which the absolute error remains constant. Confidence and tolerance limits are established for estimated rating. curves, and used for inferences regarding the error bounds on daily discharge estimates and future discharge measurements. Consideration is given to the correlation between errors in single discharge estimates, and estimates are made regarding the error bounds on monthly, semiannual, and annual discharge determinations. (Knapp-USGS) W70-03889

LARGE-SCALE UTILIZATION OF TRITIUM IN HYDROLOGIC STUDIES,

Stockholm Univ. (Sweden). International Meteorological Inst.

Erik Eriksson.

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 153-156, 1967. 4 p, 8 ref. Atomic Energy Commission Contract AT (30-1)-2458.

*Hydrologic Descriptors: properties. *Radioisotopes, *Tritium, *Tracers, *Radioactivity techniques, Water circulation, Hydrologic data, Sea water, Mixing, Aquifer characteristics, River basins, Reservoirs, Precipitation (Atmospheric), Hydrologic cycle, Hydrogeology. Identifiers: Hydrologic research.

Tritium is an excellent tracer for circulation of water in nature in many of its phases and is indispensable as a research tool during the Hydrologic Decade. The currently available data make it possible to study some large-scale phenomena like rate of exchange of water across the sea surface and rate of the exchange between sea surface water and deeper sea water. The hydrologic characteristics of river basins can also be studied, as well as similar characteristics of groundwater reservoirs. In these cases the characteristics, suitably defined, are revealed by the distortion of the tritium pulses in precipitation, which occur when water is passing through reservoirs. For full utilization of large-scale tritium as a tracer in hydrologic studies, it is necessary to collect data over many years. (Carstea-USGS) W70-03894

WATER TRACING IN THE HYDROLOGIC CY-

International Atomic Energy Agency, Vienna (Austria). L. L. Thatcher.

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 97-108, 1967. 12 p, 11 fig, 2 tab, 13 ref.

Descriptors: *Hydrologic cycle, *Tracers, *Radioisotopes, Tritium, Deuterium, Oxygen, Carbon, Water circulation, Groundwater movement, Pump testing, Stratified flow.
Identifiers: *Water tracing, Chemical tracers, Ox-

ygen-18, Carbon-14.

The use of tritium, deuterium, oxygen 18, and carbon 14 to represent circulation on the continental and hemispheric scale gives new significance to the tracing of water movement through the hydrologic cycle. The traditional concept of tracers as limited tools to obtain data about micro-areas within extensive aquifers (analogous to measuring permeability on core samples to obtain the permeability of an aquifer) is outdated by the newer techniques. The tracers of interest for investigation of the hydrologic cycle are introduced on the grand scale by natural processes and fallout, and the data obtained by observing their distributions represent integrations of transport processes over large areas. Radioisotopes have also contributed to the investigation of the local or micro-aspects of the hydrologic cycle. Radioisotope tracers have been substituted for chemical tracers in groundwater velocity and direction measurements, the investigation of stratified flow, directional information from pumping tests, and similar studies. (Carstea-USGS) W70-03900

EFFECTS OF INCONSISTENCY AND NON-HOMOGENEITY ON HYDROLOGIC TIME SE-

Colorado State Univ., Fort Collins. Dept. of Civil

Vujica Yevjevich, and Raymond I. Jeng.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 58, p 451-458, 1967. 8 p, 5 fig, 1 tab. NSF Grant GK-169.

Descriptors: *Streamflow forecasting, *Time series analysis, Rainfall-runoff relationships, Statistical methods, Probability, Correlation analysis.

Identifiers: Hydrologic time series.

The effect of inconsistency (systematic errors) and non-homogeneity of data (which are created by man-made or natural changes in environment) on properties of hydrologic variables and time series was investigated. It was assumed that inconsistency and nonhomogeneity are in the form of constant and linear jumps, linear and polynomial trends, and combinations thereof. Independent variables are used with superposed jumps and trends. Changes in probability density functions, in their mean, variance, skewness, kurtosis, and serial correlation coefficients were determined for various cases of jumps and trends. Inconsistency and non-homogeneity introduce dependence into independent time series, with the first serial correlation coefficient becoming mainly positive. As hydrologic time series are often subject to inconsistency and nonhomogeneity, a portion of positive dependence in such series comes also from these two factors, apart from other basic physical processes in nature. (Knapp-USGS)
W70-03905

THE BAYES METHODS OF STATISTICAL HYDROLOGY (FRENCH), Electricite de France, Chatou. Centre de

Electricite de France, Recherches et d'Essais.

English synopsis included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 59, p 459-470, 1967. 12 p, 4 fig, 3 tab, 4 ref.

Descriptors: *Rainfall-runoff relationships, Frequency analysis, Statistical methods, Time series analysis, Probability, Estimating, Identifiers: *Bayes methods, Hydrologic statistics.

Frequency analysis of rainfall-runoff data is often criticized because of use of incomplete information for the fitting of frequency curves. Bayes methods are used to overcome these objections. The methods are outlined and some practical examples are given for illustration. (Knapp-USGS) W70-03906

HYDROLOGIC EFFECTS OF RAINFALL AUG-

MENTATION, Stanford Univ., Calif. Dept. of Civil Engineering. Alan M. Lumb.

Technical Report No 116, Nov 1969. 114 p, 54 fig,

Descriptors: *Cloud seeding, *Hydrology, *Model studies, Computer simulation, Runoff, Floods, Evapotranspiration, Soil moisture, Reservoir

Computer simulation is employed to determine the hydrologic consequences of a 10 percent increase in precipitation as a result of cloud seeding. Two assumptions concerning the time distribution of the increase are made: (1) the increase is uniformly distributed over all hours of precipitation and (2) larger percentage increases occur during hours when precipitation is low and smaller percentage when precipitation is low and intensity rainfall.

Streamflow is simulated for the period of available rainfall record on three watersheds in New Hampshire and California. Data on the effect or

rainfall increases on total runoff, interflow, groundwater flow, soil moisture accumulation, actual evapotranspiration, and flood peaks are presented for the three watersheds. A relationship appears to exist between the ratio of annual runoff to precipitation and the percentage of annual rainfall that becomes runoff and evapotranspiration. The effect on soil moisture storage is found to be small. The increase in the mean annual flood peak and the standard deviation of the annual flood peaks is found to be a function of the percentage of precipitation that results in surface runoff and interflow with larger increases when this percentage is low. The assumption as to the distribution of rainfall increases among the hours of rainfall is found to have significant effect on flood peaks, but to have very little effect on total runoff volume or evapotranspiration. Generalized procedures are presented to permit an estimate of the hydrologic consequences of a 10 percent increase in rainfall on any watershed if mean annual precipitation and mean annual runoff are known. It is shown that it is possible to estimate the additional usable water obtainable from a 10 percent increase in rainfall for reservoirs of various sizes on a given watershed. (Linsley-Stanford) W70-03931

2B. Precipitation

POINT RAINFALL FREQUENCIES IN CON-VECTIVE STORMS,

Arizona Univ., Tucson Martin M. Fogel, and Lucien Duckstein. Water Resources Research, Vol 5, No 6, p 1229-1237, Dec 1969. 9 p, 9 fig, 2 tab, 10 ref.

Descriptors: *Precipitation (Atmospheric), *Rainfall disposition, *Frequency analysis, *Rain gages, Statistical methods, Networks, Rainfall intensity, Topography, Rainfall-runoff relationships, Probability, Depth-area-duration analysis.
Identifiers: Rainfall frequency, Convective storms.

An exponential relation was developed to describe the spatial distribution of convective storm rainfall in southwestern United States. A geometric dis-tribution was used to describe the frequencies of point rainfall depths. A Poisson distribution was assumed to represent the probability of at least one storm center occurring over a given area a specified number of times during a season. Assuming that the two probability distributions are independent and uncorrelated, maximal and minimal distributions of point rainfall depths were derived. The minimal distribution indicates that with a very high certainty a single rain gage will miss at least one convective storm a year. When compared with frequencies determined from long-term historical records, the maximal distribution exhibits a similar mean, a greater variance, and lower recurrence in-tervals for the higher rainfall depths. (Knapp-W70-03673

THE APPLICATION OF ISOTOPES TO SOME PROBLEMS IN ATMOSPHERIC SCIENCES, Atomic Energy Commission, Washington, D.C. Biology and Medicine Div. Eugene W. Bierly.

Stratosphere.

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 37-46, 1967. 10 p, 3 fig, 1 tab, 34 ref.

*Radioisotopes, Descriptors: *Meteorology, *Radioactivity techniques, Nuclear explosions, Atmospheric physics, Diffusion, Balloons, Mixing, Vortices, Meteorology.

Identifiers: *Nuclear meteorology, Troposphere,

Isotopes have been used in tracing the global transport and diffusion of nuclear weapons debris and the motions of the stratosphere and troposphere through sampling by high altitude balloons and aircrafts. In the stratosphere, the tungsten 185 cloud indicated that large scale quasi-horizontal mixing was the dominant transport mechanism. The axes of mixing are inclined to the horizontal and follow clearly the surfaces of potential vorticity. In the troposphere, the peak concentrations in the northsouth profiles of nuclear debris occur at 30 deg north or south and not at the latitude of origin, and sometimes the material is transported rapidly over great distances before being deposited on the ground. Nuclear meteorology was useful in studying exchanges between stratosphere and troposphere, and also between hemispheres. Meso- and microscale studies include: (1) Measurement of lateral and vertical diffusion coefficients of effluent flumes; (2) measurement of AgI paths when the Agl is used as a cloud-seeding agent; (3) scavenging of small particles by precipitation; and (4) deposition studies. (Carstea-USGS) W70-03690

DIFFUSIOPHORETIC AND THER-MOPHORETIC EFFECTS ON PARTICULATE MATTER NEAR CONDENSING AND EVAPORATING WATER SURFACES,

Atomic Energy Research Establishment, Didcot

Phillip Goldsmith.

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 55, 1967. 1 p.

Descriptors: *Radioactivity techniques, *Diffusion, *Evaporation, *Thermal properties, *Water vapor, Condensation, Soil moisture, Soil water movement, Tracers, Aerosols, Thermocline.

Identifiers: *Water vapor diffusion, E fusiophoretic velocity, Thermophoretic velocity.

Radioactive tracer techniques have been used to study the velocity induced on submicron aerosol particles by diffusing water vapor. Similar experiments have also been made on their velocity in temperature gradients. Often in nature, diffusing water vapor is associated with a temperature gradient in the carrier gas, for instance near a cool surface on which water is condensing. Further measurements have been carried out on the superimposed diffusiophoretic and thermophoretic velocities. The role of these mechanisms in the scavenging of particulate matter from the atmosphere is discussed in the light of these experiments. (Carstea-USGS) W70-03691

THE ATMOSPHERIC TRANSPORT OF TRITI-

UM, Stockholm Univ. (Sweden). International Meteorological Inst.

Erik Eriksson.

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 56-57, 1967. 2 p.

Descriptors: *Tritium, *Radioisotopes, *Tracers, *Radioactivity techniques, Precipitation (Atmospheric), Atmospheric physics, Nitrogen, Oxygen, Atmosphere, Nuclear explosions, Runoff, Mixing, Oceans, Water vapor. Identifiers: *Tritium circulation.

Prior to 1954, tritium was derived in nature entirely from cosmic-ray interaction with nitrogen and oxygen in the atmosphere. Since 1954, considerable amounts of tritium have been injected into the stratosphere in nuclear weapons tests. Tritium cir-culation in nature differs rather substantially from that of water. Further, the relative intensities of deposition of water and tritium are different. The net rate of tritium deposition on land is determined to a large extent by the total runoff from land. Over ocean areas, the deposited tritium will mix with a large quantity of water which will maintain a very low concentration of tritium in water vapor. The rate of removal over oceans is very effective and roughly 3 times as large as the rate of removal by precipitation. The concentration of tritium in precipitation over oceans will be much lower than that over land. (Carstea-USGS)

HURRICANE TRITIUM I: PRELIMINARY RESULTS ON HILDA 1964 AND BETSY 1965,

Miami Univ., Fla. Inst. of Marine Science. H. Gote Ostlund.

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 58-60, 1967. 3 p, 2 fig, 1 tab, 3 ref. NSF Grant GP-4534.

Descriptors: *Hurricanes, *Radioisotopes, *Radioactivity techniques, Water vapor, Tritium, Analytical techniques, Sea water, Mixing, Tropical regions, Atmospheric physics, Tracking techniques.

Identifiers: *Hurricane Hilda, *Hurricane Betsy, Low-level counting techniques.

Airborne systems were built for sampling of liquid water and water vapor for a study of tritium distribution in and around hurricanes. Refined lowlevel counting techniques were developed for extremely low tritium assays and specific activities. An electrolytic enrichment system utilizing the periodic addition method is available. The air seemed to be vertically well mixed in most areas. The tritium concentration in water vapor of undistrubed tropical air is roughly 10 times higher than that of surface sea water. When this air is entrained into a hurricane, the tritium concentration decreases approaching the eye. (Carstea-USGS) W70-03693

A NUMERICAL MODEL FOR THE HYDROLOGIC TRANSPORT OF RADIOACTIVE AEROSOLS FROM PRECIPITATION TO WATER SUPPLIES, Stanford Univ., Calif. Dept. of Civil Engineering. For primary bibliographic entry see Field 02A. W70-03698

AN ANALYSIS OF RUNS OF PRECIPITATION

EVENTS, North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering. For primary bibliographic entry see Field 07C. W70-03702

MODEL FOR GENERATING SYNTHETIC RAINFALL DEPTHS, Massachusetts Inst. of Tech., Cambridge.

R. A. Grace, and P. S. Eagleson.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 35, p 268-276, 1967. 9 p, 4 fig, 1 tab, 5 ref.

Descriptors: *Rainfall, *Forecasting, *Synthetic hydrology, *Simulated rainfall, *Mathematical models, Probability, Simulation analysis, Digital computers, Computer programs, Computer models.

Identifiers: Rainfall data.

An analytical model is developed for the synthesis of short-time-interval sequences of rainfall data. The model uses the probability distribution of the time between storms and the storm duration as well as an equivalent joint distribution of storm rainfall depth and duration to generate sequences of lumped storms which retain the stochastic features of the historical storm data. The prescribed total storm depths are then distributed over their respective durations by using a special type of urn model in such a way that the short-time-increment rainfall sequences within synthetic storms possess, on the average, the same serial correlation and percentage mass characteristics as their historical counterparts. Probability distributions and storm characteristics are obtained from 10-min summer rainfall data for a period of 5 years at St. Johnsbury, Ver-

Group 2B—Precipitation

mont. These sequences are extended synthetically, and the characteristics of the synthetic storm are shown to agree adequately with the historical attributes. Not only does the model give valid results, but it does so quickly, since it is possible to compile the necessary computer programs and then generate 15 summers of lumped storms or 5 summers of 10-min data in 3 minutes. (Knapp-USGS) W70-03703

ELEVATION EFFECTS ON RAINFALL NEAR

HOLLIS, ALASKA,
Forest Service (USDA) Juneau, Alaska. Pacific Northwest Forest and Range Experiment Station. W. J. Walkotten, and J. H. Patric.

USDA Forest Serv Res Note PNW-53, 1967. 8 p, 2 fig, 2 tab, 7 ref.

Descriptors: *Elevation, *Rainfall, Alaska, *Precipitation (Atmospheric), Meteorology, Altitude, Topography.

Records for 21 storms, ranging from 0.04 to 2.66 inches at sea level, over elevations from sea level to 1,100 feet showed an average rainfall increase of 0.02 inches per 100 feet of elevation. (Helmers-Forest Service)

A METHOD FOR STATISTICAL EVALUATION OF WEATHER MODIFICATION AT THE RIVER FLOW CONTROL LEVEL,
Colorado State Univ., Fort Collins. Dept. of Civil

Engineering.
For primary bibliographic entry see Field 03B.
W70-03848

EXTENSION OF RAINFALL RECORDS BY IN-

TERSTATION CORRELATION, Stanford Univ., Calif. Dept. of Civil Engineering. For primary bibliographic entry see Field 07A. W70-03932

2C. Snow, Ice, and Frost

FRACTURE OF LAKE AND SEA ICE, Army Terrestrial Sciences Center, Hanover, N.H. W. F. Weeks, and A. Assur.

Report available from Office of Naval Research, Dept of Navy, Wash, DC. Cold Regions Research and Engineering Laboratory Research Report 269, Sept 1969. 79 p, 57 fig, 1 tab, 174 ref.

Descriptors: *Ice, *Lake ice, *Ice breakup, *Bibliographies, *Reviews, Surveys, Rivers, Melting, Iced lakes, Ice jams, Mechanical properties, Water chemistry, Navigation, Sea ice.
Identifiers: Ice cracks, Fracturing (Ice), Pack ice,

Ice navigation, Icebreakers (Ships).

A survey of literature on the structure of ice I and the macro- microstructure of sea and lake ice includes ice chemistry and phase relations. Recent work on the direct observation of dislocations as well as the formation of cracks in ice is summarized. Formal ice-brine-air models for analyzing variations in ice strength are also reviewed. The results of the different types of tests are discussed and compared (compressive, indentation, direct and ring-tension, small beam flexure and in situ cantilevers and simple beams, shear, and impact). Scale effects are considered as well as the rapid strength deterioration experienced by ice sheets in the spring. Finally, a number of recommendations are made concerning future research in this field. (Knapp-USGS)
W70-03651

SNOW ALBEDO MODIFICATION - A REVIEW OF LITERATURE, Army Terrestrial Sciences Center, Hanover, N.H. Charles W. Slaughter.

Cold Regions Research and Engineering Laboratory Technical Report 217, Oct 1969. 25 p, 4 fig, 10 tab, 113 ref. DA Task IT061102B52A02.

Descriptors: *Albedo, *Snow, *Melting, Heat budget, Melting, Water management (Applied), Water yield, Water yield improvement, Snow-

Identifiers: *Albedo modification.

A summary of published information on snow albedo modification is presented. Consideration of energy balance parameters includes discussion of qualitative and quantitative results of albedo modification. Practical applications of albedo modification are discussed. Snowmelt retardation methods are discussed as related to reducing soil erosion and the occurrence of flash floods from glacier meltwater. Such methods as spreading dry sand, sawdust, various debris, and the use of dense smoke from burning of leaves, straw, peat, and other material to reduce the rate of melting are cited. (Knapp-USGS) W70-03652

METHODS FOR THE DETERMINATION OF MAXIMUM SNOW RESERVES IN THE RIVER BASINS OF THE CENTRAL CHERNOZEM (BLACK EARTH) BELT (RUSSIAN), State Hydrological Inst., Leningrad (USSR).

B. L. Sokolov

In: Sbornik Rabot po Gidrologii (Collection of Works on Hydrology), Gosudarstvennyi Gidrologicheskii Institute, Leningrad, Issue No 8, p 37-46, 1968. 10 p, 3 fig, 1 tab, 15 ref.

Descriptors: *Snow, *Snowmelt, *River basins, *Chernozems, *Snow cover, Precipitation (Atmospheric), Ice, Water supply, Maps, Forests, Land, Forecasting, Mathematical studies, Gaging stations, Frequency, Evaporation, Runoff. Identifiers: *USSR, Central chernozem belt.

Snow reserves in the chernozem belt basins of USSR were investigated on the basis of hydrologic data recorded at 300 gaging stations and observation points. A table shows the frequencies of maximum snow resources and maps of snow accumulation in the ravines and forest areas. (Gabriel-USGS) W70-03684

THE USE OF RADIOACTIVE TRACER GASES TO STUDY THE RATE OF EXCHANGE OF WATER VAPOR BETWEEN AIR AND NATURAL SURFACES,

Atomic Energy of Canada Ltd., Chalk River (Ontario). Environmental Research Branch.

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 69-76, 1967. 8 p, 3 fig, 3 tab,

Descriptors: *Radioisotopes, *Radioactivity techniques, *Water vapor, *Tritium, Tracers, Iodine radioisotopes, Snow, Diffusivity, Diffusion, Turbulent flow, Mass transfer, Evaporation. Identifiers: Water vapor exchange rates.

Radioactive hydrogen (tritium) as a mixed oxide with hydrogen (tritiated water or HTO) and idodine 131 have been used to measure the flux of matter at the surface of snow. The snow surface was selected because: (1) it is among the simplest of natural surfaces; (2) it is free of vegetation effects; (3) it occurs in a wide range of surface textures and roughness; (4) it is frequently renewed; and (5) an accurate sample can be collected and the radioactive tracers may be collected by melting. By using the two tracers with markedly different molecular diffusivities it was possible to study the turbulent and molecular movements separately. Comparison of experimental data with equations for calculating mass transfer rates from surface-to-air gradients showed that no existing equation predicted rates of evaporation satisfactorily. (Carstea-USGS) torily. (Carstea-USGS)

W70-03695

EROSION OF CIRQUES,

North Carolina Univ., Chapel Hill. Dept. of Geolo-

gy. For primary bibliographic entry see Field 02J. W70-03846

WEATHER AND DIURNAL FROZEN SOIL STRUCTURE AT CHARLOTTESVILLE, VIR-

Virginia Univ., Charlottesville.

Sam I. Outcalt.

Water Resources Research, Vol 5, No 6, p 1377-1382, Dec 1969. 6 p, 3 fig, 3 tab, 9 ref.

Descriptors: *Frost, *Weather, Virginia, Freezing, Frozen soils, Ice, Soil water movement, Soil moisture, Soil structure, Statistical methods. Identifiers: Soil water freezing, Frozen soil struc-

The results of a field study of weather conditions and diurnal frost structures demonstrate the effect of the atmospheric environment on the structure of soils at a site where soil water content was not a limiting factor. Statistical discrimination of soil freezing and frozen soil structures is often made possible by using late afternoon sky and dew-point temperature data. An evolutionary classification of three typical frozen soil structures is also presented (Knapp-USGS) W70-03863

2D. Evaporation and Transpiration

POTENTIAL EVAPORATION AS A MANIFES-TATION OF REGIONAL EVAPORATION, Department of Energy, Mines, and Resources, Ot-tawa (Ontario). Hydrologic Sciences Div. F. I. Morton.

Water Resources Research, Vol 5, No 6, p 1244-1255, Dec 1969. 12 p, 5 fig, 2 tab, 14 ref.

Descriptors: *Evaporation, *Mathematical models, Descriptors: "Evaporation, "Mathematical models, Energy budget, Heat balance, Water balance, Mass transfer, Meteoric water, Meteorology, Microen-vironment, Saturation, Solar radiation, Tempera-ture, Vapor pressure, Water loss, Evaporators, Hu-midity, Evapotranspiration.

The temperature and humidity of the lower atmosphere are treated as causes of evaporation from a small continuously moist area and as effects of a small continuously most area and as effects of evaporation from a large area with variable moisture supply. This leads to the formulation of a model in which the sum of the regional and poten-tial evaporation is equal to the evaporation equivalent of the absorbed insolation. Such a forequivalent of the absorbed insolation. Such a formulation permits the regional evaporation, a product of climatic, soil moisture, and vegetation processes, to be estimated by its effects on climatologic or evaporimeter observations. Test data are derived from class A evaporation pan observations from the near-arid regions of the southwestern United States, and the near-humid regions of Ireland and from records of rainfall and runoff for Irish river catchments. Comparisons with the model predictions provide good evidence for the model predictions provide good evidence for the walidity of the model and interesting insights into its hydrologic and climatologic implications. (Knapp-USGS) W70-03676

EVAPORATION FROM LARGE DEEP LAKES, Department of Energy, Mines and Resources, Cornwall (Ontario). Great Lakes-St. Lawrence

Study Office. F. I. Morton.

Water Resources Research, Vol 3, No 1, p 181-200, Jan 1967. 6 fig, 10 tab, 9 ref.

Descriptors: *Energy budget, *Evaporation, *Lakes, Lake Superior, Lake Ontario, Hydrology, Limnology.

Streamflow and Runoff—Group 2E

Identifiers: Water budget, Transitional zone, Deep lakes, Shallow lakes.

Derived insolation and water budget evaporation data for Lake Superior and Lake Ontario are analyzed in terms of both the regional and the water surface energy balances. The results indicate that the seasonal pattern of evaporation is governed by heat storage changes, and that these changes are closely associated with atmospheric energy export from the lake. This finding provides a physical basis for the simple empirical relationships between monthly evaporation and island-to-mainland temperature differentials that are developed from the water budget evaporation data. developed from the water budget evaporation data. Substantial atmospheric energy export, a concomitant of heat storage changes, reduces the energy available for evaporation. Therefore, evaporation from a large deep lake is less than that from a large shallow lake under comparable climatic conditions. The analysis also provides speculative reasoning and evidence to indicate that evaporation from a large deep lake is closely related to the radiant heat transfer to the sky. (Rietveld-Vanderbilt) W70-03717

STOCHASTIC ASPECTS OF LAKE ONTARIO EVAPORATION,
Rutgers - The State Univ., New Brunswick, N.J.;
and Cornell Univ., Ithaca, N.Y.
L. Yu Shaw, and Wilfried Brutsaert.
Water Resources Research, Vol 5, No 6, p 12561266, Dec 1969. 11 p, 7 fig, 5 tab, 13 ref. OWRR
Project A-021-NY.

Descriptors: *Evaporation, *Lake Ontario, *Stochastic processes, Markov processes, Time series analysis, Correlation analysis, Winds, Temperature, Humidity, Energy budget, Heat balance, Water balance, Statistical models, Model studies. Identifiers: Spectral analysis, Cross-spectral analy-

Time series analysis was carried out on long-term Time series analysis was carried out on long-term monthly mean values of evaporation from Lake Ontario, which were generated in an earlier study, and on related meteorologic parameters. Correlation and spectral analyses showed that the annual cycle was dominant in all the time series. Evaporation is usually high in autumn and winter and low in spring and summer. A warming trend was observed in the air temperature and a drying trend in the relative humidity series. Except for the wind speed, no significant trend was found for the other time series. Cross correlation and cross-spectral analyses showed a close relationship between evaporation anomalies and the anomalies of the other parameters. A first order Markov model adequately described the evaporation, air temperature, and relative humidity anomalies, whereas a second order model fitted the anomalies of wind speed and water surface temperature. Morton's (1967) water budget method yields higher evaporation estimates in the summer and lower estimates in the winter than the mass transfer estimates. (Knapp-USGS) W70-03872 ries. Cross correlation and cross-spectral analyses

RELATIONSHIPS BETWEEN SOIL MOISTURE ACTUAL AND POTENTIAL EVAPOTRANS-PIRATION,

Department of Agriculture, Ottawa (Ontario). Plant Research Inst. W. Baier.

W. Bater. Proceedings of Hydrology Symposium No 6 on Soil Moisture, Saskatchewan University, Nov 15-16, 1967, p 155-204, National Research Council, Ot-tawa, Canada, 1968. 50 p, 5 fig, 4 tab, 115 ref.

Descriptors: *Evapotranspiration, *Soil water movement, *Soil moisture, Soil types, Vegetation, Analytical techniques, Climatic data, Water balance, Energy budget, Solar radiation. Identifiers: Actual evapotranspiration, Potential

evapotranspiration.

Under natural conditions, actual evapotranspiration (AE) primarily depends on the available energy - or the atmospheric demand as reflected in the

potential evapotranspiration (PE) - and the availability of soil moisture. The progress made during recent years in determining AE and PE is critically reviewed. Concepts of the relationships between PE, AE and available soil moisture for different types of soil and vegetation and for various atmospheric demand rates are examined. Emphasis is on present techniques for estimating short-term variations of PE, AE and soil moisture from readily available climatological data. Examples are given for the application of such soil moisture estimates from meteorological budgets in water balance studies and agroclimatic analysis of an area. (Carstea-USGS) W70-03885

ABOUT THE ANALYTICAL METHOD FOR THE COMPILATION OF THE WATER BALANCE IN AGRICULTURE, Palermo Univ. (Italy). Istituto di Idraulica.

Ignazio Melisenda.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 82, p 659-671, 1967. 13 p, 3 fig, 4 tab, 3 ref.

Descriptors: *Hydrologic budget, *Hydrologic data, *Data processing, *Statistical methods, Regression analysis, Evapotranspiration, Rainfall, Runoff, Water balance, Farm management. Identifiers: Water budget computation.

Actual and potential evapotranspiration are compared and 2 numerical analyses are developed to define quantitatively their relation in 6 hydrographical basins typical of Sicily. The first analysis concerns the spreads among the annual values of the proportion of t evapotranspiration corresponding to the annual values of potential evapotranspiration determined for the same climatic-pedological and agricultural surroundings by means of the various formulas in use. The second analysis concerns the spreads obtime second analysis concerns the spreads obtained among the values of potential evapotranspiration for the dry season calculated by the application of drying process laws of different form. (Knapp-USGS)
W70-03901

2E. Streamflow and Runoff

FLOOD PLAIN INFORMATION, ROSILLO CREEK, BEXAR COUNTY, TEXAS. Corps of Engineers, Fort Worth, Tex. For primary bibliographic entry see Field 04A. W70-03647

DETERMINATION OF OPTIMAL FLOOD PROTECTION LEVELS WITH SMALL EXCEEDANCE PROBABILITIES, Carnegie-Mellon Univ., Pittsburgh, Pa.

For primary bibliographic entry see Field 06A. W70-03653

USE OF THE CRITICAL PERIOD IN RESER-

VOIR ANALYSIS, California Univ., Los Angeles. For primary bibliographic entry see Field 04A. W70-03655

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO AREAL INVESTIGATIONS AND MISCELLANEOUS AC-

VESTIGATIONS AND MISCELLAREOUS ACTIVITIES,
Geological Survey, Washington, D.C. Office of
Water Data Coordination.
W. W. Doyel, W. F. Curtis, and E. B. Chase.
Report available at no cost from OWDC, US
Geological Survey, Wash, DC, 20242. Geological
Survey Water Data Catalog, 1969. 161 p, 2 exhib, 3

Descriptors: *Data collections, *Hydrologic data, *Documentation, *Surveys, *Data storage and

retrieval, Networks, Monitoring, Sampling, Instrumentation, Stations, Libraries, Investigations. Identifiers: *Catalog of Information on Water

An index is presented for use in retrieving areal investigation and miscellaneous activity data from the Catalog of Information on Water Data, a record of activities in water data collection in the U.S. The Catalog is a file of information that is accessible through data-retrieval procedures--it contains information about water-data acquisition activities but does not contain the actual data, which must be obtained from the reporting agencies. Input to the Catalog consists of information supplied by Federal, State, and local agencies that acquire water data directly in the field and laboratory. All information is stored on media suitable for data processing, supplemented by microforms and maps. Information from the Catalog (output) is made available through indexes such as this publication, which is the index to the areal investigations and miscellaneous activities section of the Catalog. The indexes help the water-data user determine the The indexes help the water-data user determine the data that are available for an area and also the data available from an agency. The indexes to the 'Catalog of Information on Water Data' are indexes to separate sections of the Catalog. These indexes are designed to help the user determine what data are available that might serve his needs. (Knapp-USGS) W70-03663

FLOOD PLAIN INFORMATION, ARKANSAS RIVER, DODGE CITY, KANSAS. Corps of Engineers, Albuquerque, N. Mex. For primary bibliographic entry see Field 04A. W70-03668

GEOLOGY AND GROUNDWATER RESOURCES OF OCEAN COUNTY, NEW JER-**GROUNDWATER**

SEY, Geological Survey, Trenton, N.J. For primary bibliographic entry see Field 02F. W70-03670

ESTIMATION OF THE PARAMETERS OF GUMBEL'S THIRD ASYMPTOTIC DISTRIBUTION BY DIFFERENT METHODS,

Michigan Univ., Ann Arbor; and Georgia Inst. of Tech., Atlanta.

For primary bibliographic entry see Field 07C. W70-03674

REDUCTION OF ANNUAL RIVER FLOWS TO LONGER PERIODS (RUSSIAN),
State Hydrological Inst., Leningrad (USSR).
A. V. Rozhdestvenskiy.
In: Sbornik Rabot po Gidrologii (Collection of Works on Hydrology), Gosudarstvennyi Gidrologicheskii Institute, Leningrad, Issue No 8, p 3-13, 1968. 11 p, 3 fig, 3 tab, 4 ref.

Descriptors: *River flow, *Mathematical studies, *Analytical techniques, *Discharge (Water), Monte Carlo method, Stochastic processes, Fluctuation, Mathematical models, Gaging stations, Discharge coefficients, Water level fluctuations, Correlation analysis.
Identifiers: *USSR, Neva River, Leningrad region, Tithkinia Britage.

Tikhvinka River.

Flow discharges of the Neva River and Tikhvinka River, recorded in 1924-1953 and 1881-1953, respectively, were analyzed by using a cyclic oscillation method and the Monte Carlo method. Basilation method and the Monte Carlo method. Basically, the reduction of annual river discharges to a longer period is accomplished by separating the annual discharges into dynamical norms and random variations and by introducing a method of successive differences. Comparison of correlation functions, river discharge norms, and variation coefficients, derived by using initial and modulated seasons. cients, derived by using initial and modulated series, indicates the reliability of the described mathematical method for the analysis of a series of

Group 2E—Streamflow and Runoff

annual discharges. The reliability of the determination of a discharge dynamic norm, however, is determined by a degree of association of drainage dynamic norms of two gaging stations and their temporal stability. (Gabriel-USGS)

CALCULATION OF MAXIMUM DISCHARGES OF CRIMEAN RIVERS (RUSSIAN),

Kiev Hydrometeorological Observatory (USSR). Ye. V. Khloyeva.

Ne. V. Knioyeva. In: Sbornik Rabot po Gidrologii (Collection of Works on Hydrology), Gosudarstvennyi Gidrologicheskii Institute, Leningrad, Issue No 8, p 14-26, 1968. 13 p, 6 fig, 2 tab, 17 ref.

Descriptors: *Discharge (Water), *River basins, *Mathematical studies, Frequency, Floods, Gaging stations, Hydrologic properties, Watersheds (Basins), Precipitation (Atmospheric), Karst, Reservoirs. Identifiers: *USSR, Crimean Rivers.

Because the hydrologic regimes of rivers play an important part in the selection of suitable hydrologic structures and country roads, the maximum discharges of Crimean rivers were analyzed. The Alekseyev analytical formula, modified by the author, gives the values of maximum discharges. As a function of drainage area, tributary discharge values, regulated flow coefficient, reduction index, and flow attenuation parameter. As a result of this study two empirical formulas were developed, one for mountainous areas and the other for karstic areas. (Gabriel-USGS) W70-03682

RUNOFF VOLUME AND MAXIMUM DISCHARGES OF SPRING FLOODS APPLIED TO THE UNSTUDIED RIVERS OF KALININ-GRADSK REGION (RUSSIAN),

State Inst. for Planning Reservoir and Land Improvement Constructions, Leningrad (USSR). R. Ya. Narodetskaya.

In: Sbornik Rabot po Gidrologii (Collection of Works on Hydrology), Gosudarstvennyi Gidrologicheskii Institute, Leningrad, Issue No 8, p 27-36, 1968. 10 p, 2 fig, 1 tab, 6 ref.

Descriptors: *River flow, *Discharge (Water), *Floods, *River basins, *Analytical techniques, Hydrologic aspects, Watersheds (Basins), Vegetation, Groundwater, Geology, Humidity, Dams, Snow, Precipitation (Atmospheric), Snowmelt, Frequency.
Identifiers: *USSR, Kaliningradsk region.

The hydrologic regimes of the Kaliningradsk rivers, USSR, were investigated on the basis of maximum spring flood discharge and rainfall flood data. Spring water discharges of the majority of the rivers in Kaliningradsk region exceed the rainfall flood discharges. In general, the maps of the distribution of flood-discharge simplify the evaluation of hydrologic characteristics of unstudied rivers. (Gabriel-USGS)
W70-03683

THE DETERMINATION OF LOCAL INFLOWS ENTERING A CHANNEL,

Maryland Univ., College Park

Robert M. Ragan. French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 31, p 235-243, 1967. 9 p, 5 fig, 4 ref.

Descriptors: *Routing, *Overland flow, *Hydraulic models, *Mathematical models, *Open channel flow, Numerical analysis, Synthetic hydrology, Rainfall-runoff relationships, Streamflow forecasting, Runoff forecasting.
Identifiers: *Lateral inflows

Many recent studies have been devoted to the development of numerical solutions of the partial differential equations of free surface flow as flood routing tools. When proper measurements are made in the stream during a period of runoff, the numerical methods may also be used to compute the time and spatial distributions of the local runoff entering along the length of the channel. The advantage of the technique is that it provides a logical means of isolating land phase hydrographs for detailed study. A discussion of the approach is given and numerically generated local inflow hydrographs are compared with the lateral inflows entering along the length of a laboratory flume. The comparison showed that the approach is feasible and, in general, good agreement with the experimental data was obtained. A discussion of the sensitivities indicated by the numerical-experimental comparison is also presented. (Knapp-USGS) W70-03699

AN ERROR MODEL FOR A SINGLE DISCHARGE MEASUREMENT, Ontario Agricultural Coll., Guelph. School of

Agricultural Engineering. T. Dickinson.

French resume included. Proceeding of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 32, p 244-251, 1967. 8 p, 1 fig, 1 tab, 3 ref. Bureau of Reclamation Contract No 14-06-D-5299.

Descriptors: *Discharge (Water), *Streamflow, *Discharge measurement, *Evaluation, *Statistical methods, Theoretical analysis, Stream gages, Gaging stations, Stage-discharge relations. Identifiers: *Error analysis.

A hypothetical error model is developed for a single stream discharge measurement. The qualitative interrelationships of various component errors, and the nature of some of these errors are investigated. In particular, the robustness of sampling techniques for vertical velocity distributions, the sampling of velocity in time, and the effect of oblique currents on current-meter response are considered. Expressions are presented for the bias and the variance of a single discharge measurement in terms of the expected values and variance of the component errors. (Knapp-USGS)
W70-03700

PROPERTY OF THE RANGE OF PARTIAL SUMS,

Geological Survey, Washington, D.C. For primary bibliographic entry see Field 07A. W70-03701

STOCHASTIC STUDY OF CHANNEL DISTRIBUTION IN RIVER BASINS,
Kyoto Univ. (Japan). Dept. of Civil Engineering.
Tojiro Ishihara, Yoshiaki Iwasa, and Takuma

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 47, p 361-369, 1967. 9 p, 4 fig.

Descriptors: *River basins, *Channels, *Stochastic processes, *Geomorphology, Channel morphology, Statistical models, Networks, Probability, Distribution patterns, Shape, Drainage density, Identifiers: Drainage basin morphology.

The geometric structure of channel distribution in a river basin is a basic characteristic for the mathematical analysis of flood runoff as intensive hydrologic phenomena and for the quantitative evaluation of long range variations in configuration of river basin and runoff pattern. The stochastic process of the formation of channel distribution in a river basin under the action of external agency is analyzed by a model constructed in terms of the concept of order in quantitative geomorphology, the theory of geometric network, and the probabilistic approach. The mathematical analysis discloses the probabilistic characteristics of geometric quantities composing the channel distribution, and

it is concluded that the channel distribution converges to three statistical laws under the equilibrium condition. (Knapp-USGS) W/70-03707

STATISTICAL CONSIDERATION IN RIVER MORPHOLOGY, Institute for Water Resources, Belgrade (Yu-

goslavia). Stevan Bruk, and Miodrag Bozinovic. French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 48, p 370-375, 1967. 6 p, 6 fig, 2 ref.

Descriptors: *River basins, *Channels, *Stochastic processes, *Geomorphology, *Channel morphology, Statistical models, Networks, Probability, Distribution patterns, Shape, Drainage density, Sediment transport, Bed load, Alluvial channels, Mean-

Identifiers: River basin morphology, Ergodic processes, Morava River (Yugoslavia)

The development of alluvial rivers may be considered as a stochastic process, the channel geometry being a random function of position and time. Consequently, statistical techniques must be used in the description of bed morphology, defining the channel geometry and other values by means of distribution functions and statistical moments. Autocorrelation analysis of the channel geometry leads to characteristic lengths by which the mean-dering can be statistically described. Admitting that the development of an alluvial bed is an ergodic and stationary process, time averages and distribution functions can be replaced by space averages and distribution functions (taken along the river), by which long term predictions of values like the average bed-load transport can be made with success. The example given refers to the Morava River in Yugoslavia. (Knapp-USGS) W70-03708

ADAPTIVE FILTERS FOR TREND

TRAPOLATION OF RUNOFF RECORDS,
Deutsche Akademie der Wissenschaften zu Berlin
(East Germany). Inst. for Physical Hydrography.
For primary bibliographic entry see Field 07C.
W70-03710

UNIFIED VIEW OF DIFFUSION AND DISPER-SION.

Hilinois Univ., Urbana. Dept. of Civil Engineering. For primary bibliographic entry see Field 08B. W70-03729

MOTION OF TWO DIMENSIONAL STARTING

Waterloo Univ. (Ontario). Dept. of Mechanical Engineering; and New South Wales Univ., Kensing-

For primary bibliographic entry see Field 08B. W70-03731

LABORATORY TESTS OF SPRAYABLE MATERIALS FOR RUNOFF INDUCEMENT ON A LOESSIAL SOIL,

Hebrew Univ., Jerusalem (Israel). Faculty of Agriculture; and National Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture

D. Hillel, A. Schwartz, R. Steinhardt, and E. Rawitz.

Israel Journal of Agricultural Research, Vol 19, No 1, p 3-9, Jan 1969. 1 tab, 2 fig, 7 ref.

Descriptors: *Arid lands, *Waterproofing, *Water harvesting, *Surface runoff, *Soil treatment, Infil-tration, Soil structure, Surface sealing, Laboratory tests, Asphalt, Rainfall simulators, Surface sealing, Soil sealants, Emulsions, Rates of application. Identifiers: *Israel, Fuel oil, Latex, Wax.

Streamflow and Runoff—Group 2E

This is one of a series of reports by Hillel and colleagues on studies conducted to determine effective means of increasing runoff from slopes to planted areas. The work was conducted in arid Israel. This paper reports results of laboratory trials of 4 chemical treatments intended to seal or waterproof the soil surface to increase the runoff-rainfall ratio. Light fuel oil, latex, asphalt and wax were tested on soil-filled runoff boxes using a rainfall simulator. The treatments were found to produce 3 effects: hydrophobic, structure stabilizing and surface sealing. Low application rates tended to stabilize structure, but at higher applications, the sealing effect occurred and the runoff ratio was greatly increased. Fuel oil appeared to be the most efficient material for achieving the desired runoff increases. (Crouse-Arizona) W70-03804

ON THE EXTREME VALUE DISTRIBUTION FOR DESCRIBING ANNUAL FLOOD SERIES. New South Wales Univ., Kensington (Australia). S. H. Huxham, and C. A. McGilchrist. Water Resources Research, Vol 5, No 6, p 1404-1405, Dec 1969. 2 p, 1 fig, 9 ref.

Descriptors: *Floods, *Frequency analysis, *Probability, Statistical methods, Forecasting, Flood forecasting. Identifiers: Extreme value analysis.

Some criticisms concerning the use of the extreme value distribution for annual flood series are considered. The extreme value distribution can now be fitted easily and efficiently to extreme data. Although the theoretical extreme value distribution is only an asymptotic result, for moderate sample sizes an extreme value distribution with parameters different from the theoretical ones is often a good fit to the data. (Knapp-USGS) W70-03854

A PEAK DISCHARGE RELATION FOR INTER-

MEDIATE DRAINAGE BASINS, Queen's Univ., Kingston (Ontario). W. E. Watt, and R. J. Kennedy. Water Resources Research, Vol 5, No 6, p 1406-1409, Dec 1969. 4 p, 4 fig, 4 ref.

Descriptors: *Peak discharge, *Flood forecasting, *Probability, Streamflow forecasting, Statistical methods, Frequency analysis, Routing.
Identifiers: Intermediate drainage basins, Ontario (Canada).

For ungaged drainage basins of intermediate size, a peak discharge-frequency relation may be deter-mined from a frequency distribution of rainfall ex-cess and a method for relating peak discharge to rainfall excess. For short-period hydrographs a one-parameter peak discharge relation employing the basin lag is satisfactory. Analysis of the records of 45 isolated intense storms on 12 drainage basins in southern Ontario provided satisfactory confirmation of the above relation. (Knapp-USGS) W70-03855

A TEN-UNIT WATER LEVEL SENSING AND RECORDING SYSTEM,
Maryland Univ., College Park.

For primary bibliographic entry see Field 07B. W70-03857

ESTIMATION OF STATISTICAL PARAME-TERS FOR ANNUAL RIVER FLOWS, Universidad Nacional del Zulia, Maracaibo

(Venezuela). Ugnacio Rodriguez-Iturbe. Water Resources Research, Vol 5, No 6, p 1418-1421, Dec 1969. 4 p, 1 fig, 2 tab, 9 ref.

Descriptors: *Streamflow forecasting, *Statistical models, Statistical methods, Markov processes, Sampling, Correlation analysis, Time series analy-

Identifiers: Annual river flow series.

A first order Markov process is chosen as representative for annual river flows. The normalized standard errors of the estimates of the mean, the variance, and the first autocorrelation coefficient are shown as functions of the sample size for a river which is considered to have average statistical characteristics. The theoretical analysis is complemented with a study of the variations with sample size of the main statistical parameters of three rivers with a large amount of data. On the average between 40 and 60 years of data are desirable to estimate the mean and the variance. The normalized standard error grows rapidly with any diminishing of the sample size. Beyond this range the normalized standard error of estimate decreases slowly with lengthening sample size. Large errors appear to be common in estimating the first autocorrelation coefficient, even for series whose length is much longer than is normally found. (Knapp-USGS)
W70-03858

COMPARISON OF SMART AN SCHEIDEGGER STREAM LENGTH MODELS, AND IBM Watson Research Center, Yorktown Heights,

J. S. Smart.

Water Resources Research, Vol 5, No 6, p 1383-1387, Dec 1969. 5 p, 1 tab, 11 ref.

Descriptors: *Drainage patterns (Geologic), *Statistical models, Drainage density, Networks, Tributaries, Statistical methods, Geomorphology, Channel morphology.
Identifiers: *Stream length models, Stream order.

The Smart and Scheidegger stream length models are compared and shown to have similar concepts. Discrepancies in the general conclusions reached by the two authors arise from different methods of developing the models and of making comparisons with observation. The results of analysis of Scheidegger's procedures and the results of tests designed to avoid some of the difficulties encountered there fail to lend any support to the suggestion that interior link lengths increase with stream order. (Knapp-USGS) W70-03862

CONSTRAINED RANDOM WALK MEANDER GENERATION,

IBM Watson Research Center, Yorktown Heights,

Alvin J. Surkan, and Joseph Van Kan. Water Resources Research, Vol 5, No 6, p 1343-1352, Dec 1969, 10 p, 11 fig, 2 tab, 9 ref.

Descriptors: *Drainage patterns (Geologic), *Statistical models, *Meanders, *Stream erosion, Sediment transport, Statistical methods, Monte Carlo method, Stochastic processes, Markov

Identifiers: *Random-walk models.

Analyses of meander data and comparison of models based on von Schelling's theory of random walks for isotropic Gaussian deviations yield constraints satisfactory for simulation of realistic meander paths. Runge-Kutta solutions of the differential equation for most probable paths exhibit excessive regularity. Calculation of correlation functions, transition probability matrices, and second moments for natural meander data as a function of segment direction reveals important defunction of segment direction reveals important dependency on segment ordering and shows isotropic random walk models to be untenable. Neither the directions, curvatures, nor their changes in natural meanders are Gaussian independent. Necessary constraints on random walk deviations for simulating meanders include a significant positive correla-tion for adjacent curvatures and directions and often a negative one between the curvature changes. Both result from azimuth dependence in the second moment of the curvature. The application of a directional property of meander curva-tures makes possible (1) simulation of realistic meander paths, (2) statistical determination of flow direction, and (3) numerical evidence of a undirectional flow origin for any meander-like path. (Knapp-USGS) W70-03866

A WORKING MODEL FOR THE VARIATION IN STREAM WATER CHEMISTRY AT THE HUBBARD BROOK EXPERIMENTAL FOREST. NEW HAMPSHIRE,

Dartmouth Coll., Hanover, N.H.; Yale Univ., New Haven, Conn.; Geological Survey, Washington, D.C.; and Forest Service (USDA), Durham, N.H. For primary bibliographic entry see Field 02K. W70-03867

FLOOD PLAIN INFORMATION, LOOKING-RIVER, CLINTON COUNTY. MICHIGAN.

Corps of Engineers, Detroit, Mich. For primary bibliographic entry see Field 04A. W70-03868

DISTRIBUTION OF INTERIOR LINK LENGTHS IN NATURAL CHANNEL NET-

IBM Watson Research Center, Yorktown Heights, N.Y.

J. S. Smart.

Water Resources Research, Vol 5, No 6, p 1337-1342, Dec 1969. 6 p, 2 fig, 3 tab, 13 ref.

Descriptors: *Drainage patterns (Geologic), *Statistical models, Drainage density, Tributaries, Statistical methods, Geomorphology, Channel morphology.
Identifiers: Nonparametric statistics.

Interior link lengths were measured for 10 channel networks with magnitudes between 80 and 200. Nonparametric statistical methods were used to test the hypothesis that link length is independent of link magnitude. Four of the networks show no significant change (5% level) of link length with magnitude. Some of the other networks do have significant changes in link length, but the exact number depends on the nature of the alternative hypothesis. Half of the observed changes were positive and half were negative. (Knapp-USGS) W70-03878

PURPOSE AND PERFORMANCE OF PEAK PREDICTIONS,
Pennsylvania State Univ., University Park, Pa. Dept. of Civil Engineering; and Colorado State Univ., Fort Collins. Dept. of Civil Engineering. For primary bibliographic entry see Field 04A.

DISCRIMINATING THE CHANGE IN MEANS OF HYDROLOGIC VARIABLES, Colorado State Univ., Fort Collins. Dept. of Civil

Engineering.

For primary bibliographic entry see Field 04A. W70-03888

TRENT BASIN STOCHASTICS,

Manchester Univ. (England). Dept. of Engineer-

Harmindar S. Takhar.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 81, p 648-658, 1967. 11 p, 2 fig, 1 tab.

Descriptors: *Streamflow, *Stochastic processes, Statistical methods, Statistical models, Stream gages, Data collections, Hydrologic data. Identifiers: *England, *River Trent.

The River Trent is one of the main British rivers. The actual headwaters rise on the springs of the Millstone Grit deposits of the Upper Carboniferous System of rocks at an approximate height of 926 feet above sea level. The total length of the River

Group 2E—Streamflow and Runoff

Trent from the highest headwater stream to the Trent Falls is 173.20 miles draining a total of Non-Tidal area of 3178.68 square miles through different conurbations and morphological situations. A quantitative study of some simple statistical parameters derived from the daily mean flows of the entire Trent basin is made. Qualitative inferences are drawn from these statistical parameters about the nature of the flows to be expected. Spatial and temporal variations of these parameters are shown to reflect in the corresponding behaviors of the river flows. Arguments are also initiated to relate the significance of the simple river stochastics to the existing geology of the basin. (Knapp-USGS) W70-03902

SEQUENCE DROUGHT GENERALIZED PROBABILITIES STORAGE-DRAFT-FOR

PROBABILITIES FOR STORAGE-DRAFT-FREQUENCY ANALYSIS, University of the Witwatersrand, Johannesburg (South Africa). Dept. of Hydraulic Engineering. Desmond C. Midgley.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 57, p 443-450, 1967. 8 p, 2 fig, 8 ref.

Descriptors: *Streamflow forecasting, *Statistical methods, *Mass curves, Probability, Equations, Duration curves, Hydrographs, Rainfall-runoff relationships, Stage-discharge relations, Stream gages, Networks, Data collections, Water storage. Identifiers: Stream gaging.

Independent deficient flow sequences of increasing duration, abstracted from the streamflow data of rivers having relatively long records, were sub-jected to extreme value analysis (Gumbel). The ordinates of the resulting families of annual mass curves, having recurrence interval as parameter, were rendered dimensionless by dividing by mean annual riverflow and were then generalized on a re-gional basis. An empirical equation was developed to describe the resulting families of critical mass curves and the characteristic constants of the equation were evaluated for several regions of South Africa. (Knapp-USGS) W70-03904

A PRINCIPAL COMPONENT ANALYSIS OF SURFACE RUNOFF DATA FROM A NEW ZEALAND ALPINE WATERSHED, Harvard Univ., Cambridge, Mass. Dept. of Engineering and Applied Physics.
Leo M. Eiselstein.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 61, p 479-489, 1967. 11 p, 7 tab, 15 ref.

Descriptors: *Rainfall-runoff relationships, *Statistical methods, *Unit hydrographs, *Correlarelationships, rotation analysis, Small watersheds, Antecedent precipitation, Infiltration, Evapotranspiration, Regression analysis, Synthetic hydrology, Statistical models.

Identifiers: *New Zealand, Principal component

The analysis of surface runoff data from small watersheds by principal component analysis with varimax rotation of the factor weight matrix is varimax rotation of the factor weight matrix is discussed. An example of principal component regression analysis applied to surface runoff data from an experimental watershed near Christchurch, New Zealand is presented. It is suggested that this analysis method would be suitable for correlating the surface characteristics of a small watershed with the presentance of a surface that the presentance of a small surface. watershed with the parameters of a unit hydrograph model. Principal component regression analysis with varimax rotation of the factor weight matrix could therefore be used for the 'synthesis' of flow records for ungaged small watersheds. (K-napp-USGS) W70-03908

APPLICATION OF RUNS TO HYDROLOGIC DROUGHTS.

Vermont Univ., Burlington. Dept. of Civil Engineering; and Colorado State Univ., Fort Collins.
Dept. of Civil Engineering.
Richard N. Downer, M. M. Siddiqui, and V.

Yevjevich.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 63, p 496-505, 1967. 10 p, 4 fig, 1 tab, 1 ref.

Descriptors: *Droughts, *Streamflow forecasting, *Rainfall-runoff relationships, *Time series analysis, Stochastic processes, Probability, Statistical methods, Statistical models, Synthetic hydrology. Identifiers: Drought statistics, Statistical runs.

On the basis of the theory of runs, an objective definition of hydrologic drought is set forth. The definition takes into account both the duration and magnitude of the drought. Two concepts are outlined: that of the run-length, which indicates the duration of the drought; and that of run-sum, which indicates the magnitude of the drought. Once the reference value or the probability of the reference value for the drought has been selected, the definition can be objectively applied to any time series. Equations of the properties of run-length and run-sum are derived analytically for independent random variables and applied to the independent nor-mal standard variable. The data generation method was used on the independent normal standard variable to check the analytical solutions. The comparison indicated that the data generation method was satisfactory, and it was then applied to the in-dependent standard log-normal variable with various skewnesses to derive its properties of runs. (Knapp-USGS) W70-03909

EFFECTS OF SAMPLING INTERVAL. PERIODICITY, DEPENDENCE SKEWNESS ON EXTREME VALUES. AND Colorado State Univ., Fort Collins. Dept. of Civil

Engineering David F. Kibler, and Vujica Yevjevich.

French resume included. Research sponsored by National Science Foundation. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 67, p 537-545, 1967. 9 p, 11 fig, 3 ref. NSF Grant GK-169.

Descriptors: *Streamflow forecasting, *Flood forecasting, *Statistical methods, *Probability, Sampling, Hydrographs, Duration curves, Mass curves, Time series analysis, Stochastic processes, Synthetic hydrology. Identifiers: Extreme value theory.

In order to test the validity of extreme value theory as applied to hydrologic extremes, a study has been made of the effects of sampling interval (in which the extreme value is selected), periodicity, dependence, and skewness on the frequency distributions of extreme values. A standard normal initial distribution is first obtained by data generation techniques. Periodicity, dependence, and skewness are superimposed on the initial standard normal distribution. The Gumbel double-exponential distribution curve is then fitted to the generated extribution curve is then fitted to the generated ex-tremes and distribution parameters, and dispersion tremes and distribution parameters, and dispersion index and mode are computed. Results are presented as a series of graphical plots which illustrate the distribution parameters as they vary with changing sampling intervals, harmonic amplitude, sequential dependence, and skewness in the initial distributions. (Knapp-USGS)

2F. Groundwater

STATISTICAL EVALUATION OF SALINITY AND NITRATE CONTENT AND TRENDS

BENEATH URBAN AND AGRICULTURAL AREA-FRESNO, CALIFORNIA,
Agricultural Research Service, Fresno, Calif.

Groundwater Research Service, Fresno, Groundwater Recharge Field Station.
For primary bibliographic entry see Field 05B.
W70-03649

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO GROUND-

DATA, EDITION 1968 - INDEX TO GROUND-WATER STATIONS, Geological Survey, Washington, D.C. Office of Water Data Coordination.
J. R. Rapp, W. W. Doyel, and E. B. Chase.
Report available at no cost from OWDC, US Geological Survey, Wash, DC, 20242. Geological Survey Water Data Catalog, 1969. 657 p, 1 fig, 1 exhib, 4 tab.

Descriptors: *Data collections, *Hydrologic data, *Documentation, *Surveys, *Groundwater, Water wells, Data storage and retrieval, Networks, Monitoring, Sampling, Instrumentation, Stations, Libraries, Investigations.
Identifiers: *Catalog of Information on Water

An index is presented for use in retrieving data on groundwater measuring stations, from the Catalog of Information on Water Data, a record of activities in water data collection in the U.S. The Catalog is a file of information that is accessible through dataretrieval procedures--it contains information about water-data acquisition activities but does not contain the actual data, which must be obtained from the reporting agencies. Input to the Catalog conthe reporting agencies. Input to the Catalog consists of information supplied by Federal, State, and local agencies that acquire water data directly in the field and laboratory. All information is stored on media suitable for data processing, supplemented by microforms and maps. Information from the Catalog (output) is made available through indexes such as this publication, which is the index to the groundwater section of the Catalog. The indexes help the water-data user determine the data that are available for an area and also the data. that are available for an area and also the data available from a reporting agency. The indexes to the 'Catalog of Information on Water Data' are indexes to separate sections of the Catalog. These in-dexes are designed to help the user determine what data are available that might serve his needs. In this index to groundwater stations, the stations are grouped (1) by States, (2) by counties within the States, and (3) by agencies within the counties. (Knapp-USGS)
W70-03658

BIBLIOGRAPHY OF THE GROUNDWATER RESOURCES OF NEW YORK THROUGH 1967, Geological Survey, Albany, N.Y.
R. D. MacNish, R. C. Heath, L. E. Johnson, R. A. Wilkens, and R. D. Duryea.
New York State Water Resources Commission Bulletin 66, 1969. 186 p, 3 fig, 2 index.

Descriptors: *Bibliographies, *Groundwater, *New York, *Water resources, Water supply, Aquifers, Water wells, Water resources development, Water levels, Surveys, Data collections, Hydrologic data, Information retrieval. Identifiers: Water Resources Bibliography.

A bibliography lists the groundwater resources studies in New York through 1967. Considerable information concerning New York water-bearing strata is available in a large variety of publications. The purpose of this bibliography is to list all these references in a single publication as an aid to future studies of New York's groundwater resources. In addition to the annotated bibliography, which summarizes the contents of each reference, a large part of the report is allocated to location and subject inof the report is allocated to location and subject indexes of the references. The location index allows the reader to look under a specific area and find all the reader to look under a specific area and informal publications dealing with any aspect of the ground-water resources of that area. The subject index permits the reader to look under the principal subjects related to groundwater resources and find material

related to areas in New York published on a specific subject. Published reports on the groundwater resources of New York range from detailed reports on small areas to general reports covering the entire State. (Knapp-USGS) W70-03659

COMPILATION OF RESULTS OF AQUIFER TESTS IN TEXAS.

Geological Survey, Austin, Tex.

B. N. Myers.

Report published and distributed by the Tex Water Development Bd, P.O. Box 12386, Austin, Tex, 78711. Texas Water Development Board Report 98, July 1969. 532 p, 4 fig, 1 tab, 8 ref.

Descriptors: *Aquifers, *Texas, *Specific capacity, *Aquifer characteristics, *Data collections, Hydrologic data, Permeability, Drawdown, Trans-Institute of the missivity, Hydrologic properties, Documentation, Information retrieval.

Identifiers: *Aquifer testing, Pumping tests.

Aquifer tests made in Texas are compiled and evaluated. Some of the tests were conducted with little or no prior knowledge of the geologic framework of the aquifer; consequently, the reliability of such tests was questionable. However, on the basis of additional field testing or supporting geologic data, a few of the initially calculated results (some of which have been published) were revised. The

form in which the material is presented is probably complete enough to permit the user of the data to reevaluate the results or make other interpretations. The data are grouped by county and where possible the latitude and longitude of the well are given. (Knapp-USGS) W70-03660

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO AREAL INVESTIGATIONS AND MISCELLANEOUS AC-

TIVITIES,
Geological Survey, Washington, D.C. Office of

Water Data Coordination.

For primary bibliographic entry see Field 02E. W70-03663

GEOLOGY AND **GROUNDWATER** RESOURCES OF OCEAN COUNTY, NEW JER-

Geological Survey, Trenton, N.J. Henry R. Anderson, and Charles A. Appel.
New Jersey State Division of Water Policy and Supply Special Report 29, 1969. 93 p, 29 fig, 10 tab, 20 ref.

Descriptors: *Water resources, *Aquifers, *Groundwater, *New Jersey, Water yield, Water levels, Water quality, Water supply, Artesian wells, Water wells, Data collections, Hydrologic data,

Hydrogeology. Identifiers: Ocean County (NJ).

The aquifers of Ocean County, New Jersey, are continental, near-shore marine, beach, or deltaic deposits of porous sand and gravel; the confining beds are chiefly deeper water marine deposits of clay and glauconite. Generally, the Coastal Plain formations are more permeable near their outcrop, where shallow-water deposits occur, than downdip where marine clays and glauconites occur. Groundwater in Ocean County is obtained principally from four artesian aquifer systems and a water-table aquifer. The formations of Cretaceous age form an artesian aquifer system 600 to 2,000 feet thick. Well yields of 500 to 1,000 gpm can be expected. Potable water in the aquifer system is soft (29 to 51 ppm hardness) and is generally high in iron content (0.66 to 3.2 ppm). Temperatures of 70 to 90 deg F make the water less desirable than shallow water for cooling purposes. (Knapp-USGS) W70-03670

UPCONING OF FRESH WATER-SEA WATER INTERFACE BELOW PUMPING FIELD STUDY, WELLS

Ministry of Agriculture, Jerusalem (Israel). Hydrological Service; and Water Planning for Israel Ltd., Tel-Aviv.
For primary bibliographic entry see Field 04B.
W70-03677

FORMATION AND GEOLOGICAL ROLE OF GROUNDWATERS,

Leningrad State Univ. (USSR). A. Ye. Khod'kov, and G. Yu. Valukonic. Leningrad, Izdatel'stvo Lenin Leningradskogo

Universiteta, 1968. 216 p, 23 fig, 23 tab, 326 ref. *Groundwater, *Groundwater Descriptors: Descriptors: "Groundwater, "Groundwater recharge, *Hydrogeology, *Water structure, Water types, Water chemistry, Water circulation, Water sources, Fluid mechanics, Sediments, Density,

Sedimentation, Atmospheric physics, Geochemistry, Infiltration, Aquifers. Identifiers: Groundwater resources.

The present status of hydrogeology in the USSR is reviewed. Data pertaining to the composition, properties, and structure of water and the hydrosphere are given and the mechanism, development, and the hydrogeological effects of groundwaters are analyzed. The monograph contains the following chapters: the composition, structure, and properties of water; hydrosphere evolution; main genetic types of groundwaters and water circulation; the types of hydrodynamic zoning and the basic laws governing the fluid dynamics of condensing sediments; factors and processes of the formation of chemical composition of groundwaters; formation of groundwaters of sedimentary origin; formation of groundwaters of atmospheric origin; geochemical role of groundwater migration; and the geological role of groundwaters. (Gabriel-USGS) W70-03679

HYDROLOGIC RECONNAISSANCE OF SKULL

HYDROLOGIC RECONNAISSANCE OF SKULL VALLEY, TOOELE COUNTY, UTAH,
Geological Survey, Salt Lake City, Utah; and Utah Dept. of Natural Resources. Div. of Water Rights.
J. W. Hood, and K. M. Waddell.
Utah Department of Natural Resources, Technical Publication No 18, 1968. 57 p, 11 tab, 8 fig, 34 ref.

Descriptors: *Arid lands, *Utah, *Groundwater, *Evapotranspiration, *Water quality, Groundwater basins, Groundwater recharge, Precipitation (Atmospheric), Groundwater movement, Water chemistry, Water yield, Hydrologic budget, Wells, Surface waters, Hydrogeology, Surveys. Identifiers: *Skull Valley (Utah).

Skull Valley is about 50 miles long extending northward from Lookout Pass to the Great Salt Lake. The main groundwater supply underlies about 230,000 acres of unconsolidated rocks of the late Tertiary and Quaternary. All water input is precipitation, most of which falls on the surrounding mountains. Total annual estimated recharge ranges from 30,000 to 50,000 acre feet of which about 80 to 90% is lost to evapotranspiration. Perennial groundwater yield is estimated at 10,000 acre feet or less. Water quality is generally very poor with dissolved solids ranging up to 17,000 ppm. An estimated one million acre feet is of quality suitable for irrigation or domestic use. Most of this lies under the alluvium bordering the mountains on the south and eastern sides of the valley. (Crouse-Arizona) W70-03811

ANISOTROPIC PERMEABILITY OF FRAC-TURED MEDIA,

Colorado School of Mines, Golden.

David T. Snow.

Water Resources Research, Vol 5, No 6, p 1273-1289, Dec 1969. 17 p, 5 fig, 5 plate, 32 ref.

Descriptors: *Permeability, *Anisotropy, *Porous media, *Fractures (Geology), *Mathematical models, Model studies, Darcys law, Statistical models, Mathematical studies, Discharge (Water), Flow, Groundwater movement.

Identifiers: Anisotropic permeability, Fractured porous media.

The mathematical equivalents of parallel plate openings are used to simulate real fractures dispersed in orientation, distributed in aperture, and of arbitrary spacing. The discharge of each conductor is a second rank tensor proportional to conductor is a second rank tensor proportional to the cube of aperture and to the projection of a hydraulic gradient generally parallel to no conduc-tor. Components of discharge through each intertor. Components of discharge through each intersecting conductor and components of discharge through intervening pervious blocks may be added. The reciprocal of specific surface of the fracture system is a weighting factor for the tensor sum, which is the anisotropic Darcy's law permeability of an equivalent continuous medium. Special cases of one, two, and three joint sets are modeled by applicable of the property of the set plying Monte Carlo methods to pair orientations of individual planes sampled from Fisher dispersions with apertures sampled from skewed normal distributions. Statistics of the orientation of principal axes and of principal permeabilities are developed to show the relationship between joint geometry and anisotropy and to assess its variations. (Knapp-USGS) W70-03870

DETERMINING SPECIFIC YIELD OF THE OGALLALA AQUIFER BY THE NEUTRON METHOD,

Agricultural Research Service, Bushland, Tex. Southwestern Great Plains Research Center.
Ordie R. Jones, and Arland D. Schneider.
Water Resources Research, Vol 5, No 6, p 12671272, Dec 1969. 6 p, 5 fig, 2 tab, 10 ref.

Descriptors: *Specific yield, *Aquifers, *Alluvium, *Nuclear moisture meters, Texas, Instrumentation, Surveys, Radioactivity, Water levels, Water level fluctuations, Permeability.

Identifiers: Ogallala Formation, Neutron moisture meters, Pumping tests, Aquifer testing.

The specific yield of the Ogallala formation, a water table aquifer, was determined with a neutron moisture meter. An access tube penetrated a 12-foot section of the aquifer. This section was satu-rated by recharging water to the aquifer and then dewatered by pumping for 11 days. The specific yield of the aquifer was calculated from neutron moisture measurements made at saturation after most gravity drainage had occurred. The average specific yield for 25 measurements made at 1/2specific yield for 25 measurements made at 1/2-foot intervals was 0.22. This value compares favorably with the specific yields determined by tracer techniques and laboratory analysis of cores. However, the specific yield determined by the neutron method was 50% greater than the specific yield determined by pumping tests. (Knapp-USGS) W70-03871

AVAILABILITY OF GROUNDWATER IN WAYNE COUNTY, IOWA, Geological Survey, Iowa City, Iowa. J. W. Cagle. Iowa Geological Survey Water Atlas No 3, 1969.

33 p, 10 fig, 6 tab.

Descriptors: *Water resources, *Water quality, *Groundwater, *Aquifers, *Iowa, Nitrates, Saline water, Water chemistry, Water supply, Water yield, Water wells, Water pollution sources, Geology, Glacial drift. Identifiers: Wayne County (Iowa).

Information is presented on the availability and quality of groundwater in Wayne County, one of several counties in southern Iowa affected by a shortage of good-quality water. Only locally and in limited areas, or only after extensive water-quality treatment, are suitable supplies of groundwater

Group 2F-Groundwater

available to satisfy the water needs. Bedrock aquifers yield variable small amounts of moderately to highly mineralized water. Surficial aquifers comprising glacial drift and alluvium are estimated to yield up to 45 gpm in some areas; an availability map indicates the areas where water supplies can developed. Dissolved-solids concentrations range from about 470 mg/l in the alluvium to over 3,600 mg/l in the deep (more than 100 feet) glacial drift. Many shallow (100 feet or less) supplies presently in use contain high concentrations of nitrate and chloride, and these concentrations are attributed to localized contamination. Wells in the alluvium and shallow drift that are properly constructed and located are expected to yield satisfactory quality water. (Knapp-USGS) W70-03879

RADIOCARBON DETERMINATIONS APPLIED TO GROUNDWATER HYDROLOGY,

Geological Survey, Washington, D.C.; and Geological Survey, Denver, Colo.
Bruce B. Hanshaw, Meyer Rubin, and William

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 117-118, 1967. 2 p, 3 ref.

Descriptors: *Carbon radioisotopes, *Radioactive Descriptors: Carbon fautonscender, *Tracking dating, *Groundwater movement, *Tracking techniques, *Tracers, Acidity, Alkalinity, Carbonates, Carbon dioxide, Groundwater recharge, hemistry Saturation, Carbon, Water Geohydrologic units, Hydrogeology. Identifiers: *Groundwater hydrology chemistry.

Field determination of pH, alkalinity and the use of stable isotopes can correct some chemical problems associated with use of radiocarbon in problems associated with use of radiocarbon in hydrology. These chemical problems are: (1) Determination of initial C-14 levels in the recharge area; (2) water saturation with respect to car-bonate minerals; (3) isotopic exchange after satu-ration is attained; and (4) introduction of carbon dioxide from noncarbonate sources. The amount of nonradiogenic carbon introduced into groundwater can be determined by taking advantage of the range of C-13 values in nature. Atmospheric carbon dioxide is depleted only slightly in C-13, whereas plants, wood and coal are quite depleted in C-13. In contrast, carbon dioxide from thermal areas is commonly much enriched in C-13. In aquifers that contain carbonate minerals, the C-13 correction can be applied to determine the amount of nonradiogenic carbon dilution in order to correct the raw C-14 age and calculate a corrected C-14 age. Field studies have been conducted in 14 age. Field studies have been conducted in selected aquifers (1) to measure the relative C-14 concentrations and C-13 values; (2) distinguish between the waters from different geohydrologic environments; (3) calculate velocity of groundwater movements; and (4) delineate areas of significant recharge. (Carstea-USGS) W70.0380

DEVELOPMENT OF ISOTOPE METHODS AP-PLIED TO GROUNDWATER HYDROLOGY, Weizmann Inst. of Science, Rehovoth (Israel).

Dept. of Isotopes. For primary bibliographic entry see Field 07B. W70-03891

GROUNDWATER FLOW AND DIRECTION MEASUREMENT BY MEANS OF RADIOISOTOPES IN A SINGLE WELL, J. Mairhofer.

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 119-129, 1967, 11 p, 12 fig,

Descriptors: *Groundwater *Radioisotopes, *Radioactivity techniques,
*Tracers, Wells, Tritium, Precipitation (Atmospheric), Flow measuremer., Aquifers, Permeability, Nuclear explosions, Hydrogeology. Identifiers: *Point dilution method, Groundwater

The point dilution method was used in studies of aquifer flow velocity measurements using single, cased water wells. The casing was sealed above and below the measuring point in the well. The space between the screen and hole must be tight in order to minimize vertical movement. Radioisotope measurements of aquifer permeability and groundwater movement are discussed. The chemical form of the injected tracer must be taken into account to correct for adsorption, etc. (Carstea-USGS) W70-03892

USE OF CHEMICAL AND RADIOACTIVE TRACERS AT THE NATIONAL REACTOR TESTING STATION, IDAHO,

National Reactor Testing Station, Idaho Falls,

Donald A Morris

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 130-142, 1967. 13 p, 11 fig, 3 tab, 4 ref.

Descriptors: *Radioactivity techniques, *Tracers, *Tritium, *Groundwater movement, techniques, Idaho, Waste disposal, Nuclear reac tors, Flow rates, Aquifers, Basalts, Dye releases, Xray fluorescence, Hydrogeology.
Identifiers: *National Reactor Testing Station,

Chemical tracers, Radioactive tracers.

Chemical and radioactive tracers were used in studies of the geology and the hydrology of the basalt terrane at the National Reactor Testing Station. A salt tracer, used near waste disposal from the Idaho Chemical Processing Plant, indicated rates of flow ranging from 15 to 50 ft/day in the regional groundwater reservoir, and a sodium fluorescein dye indicated an average rate of flow of about 23 ft/day. Recent studies using tritium indicated average rates of flow of about 54 ft/day based on first arrival and from 10 to 13 ft/day based on the arrival of the center of mass or maximum tritium concentration. Studies of the water perched in the alluvium and basalt underlying the Test Reactor Area indicated a rate of flow of about 2-10 ft/day. Long-range tritium studies in the regional groundwater reservoir in the Central Facilities Area indicated rates of flow of 6-8 ft/day under normal hydraulic gradients of 5 ft/mile at distances of 4-5 miles from points of injection. (Carstea-USGS) W70-03893

RADIOCARBON AGES OF GROUNDWATER IN AN ARID ZONE UNCONFINED AQUIFER,
Instituto Venezolano de Investigaciones Cien-

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 143-152, 1967. 10 p, 2 fig, 3 tab, 17 ref.

Descriptors: *Carbon radioisotopes, *Radioactive dating, *Aquifer characteristics, Carbonates, Cardating, "Adulier enaracteristics, Carbonates, Car-bon dioxide, Bicarbonates, Groundwater recharge, Saline water intrusion, Water supply, Water resources development, Arid climates. Identifiers: *Venezuela, *Maracaibo, *Ground-

The use of the naturally occurring stable isotope C-13 was studied to estimate the amount of limestone that has dissolved in groundwater. Limestone contains essentially no C-14, and has 2.5% more C-13 than plants and 0.8% more than atmospheric car-bon dioxide. Advantage can be taken of these dif-ferences in C-13 to estimate the contribution of dissolved carbonate derived originally from limestone. The dissolved carbon dioxide and bicarbonate content in the groundwater aquifer of the city of Maracaibo, Venezuela, were used for radiocarbon dating. The radiocarbon activities were corrected for the dilution of the activity by limestone. The ex-

perimental results suggest that the groundwater aquifer is not being recharged and at the present rate of water consumption, the supply could last 350 years. If population growth is taken into consideration, the groundwater aquifer would be exhausted in less than 80 years. The probability of sea water intrusion into the aquifer is discussed. (Carstea-USGS) W70-03895

TECHNIQUES OF GROUNDWATER TRACING

USING RADIONUCLIDES, Atomic Energy of Canada Ltd., Chałk River (On-

W. F. Merritt.

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 169-170, 1967. 2 p, 2 ref.

Descriptors: *Tracers, *Groundwater movement, *Radioisotopes, Tracking techniques, Tritium, Gamma rays, Analytical techniques, X-ray analysis, Carbon radioisotopes, Iodine radioisotopes, Phosphorous radioisotopes.

Identifiers: *Groundwater tracing, Liquid scintilla-

Radionuclide techniques commonly used for tracing groundwater are discussed. Tritium is cheap, easy to handle and moves with groundwater, but is difficult to count. Pure beta emitters (Sr-35, P-32, C-14) are easy to count, but the last two may be fixed by soil bacteria. Gamma emitters (Br-82, I-131) can be detected in the field but may require shielding during handling. Liquid scintillation, windowless flow proportional, and well-type crystal counting methods were compared. Techniques for measuring the direction and velocity of ground-water flow used at Chalk River Nuclear Laboratories are given. (Carstea-USGS) W70-03896

ENVIRONMENTAL TRITIUM STUDIES AT THE NATIONAL REACTOR TESTING STA-

Atomic Energy Commission, Idaho Falls, Idaho. For primary bibliographic entry see Field 05B. W70-03898

THE USE OF A TRACER TEST TO VERIFY AN ESTIMATE OF THE GROUNDWATER VELOCITY IN FRACTURED CRYSTALLINE ROCK AT THE SAVANNAH RIVER PLANT NEAR AIKEN, SOUTH CAROLINA,

Geological Survey, Aiken, S.C.

I. Wendell Marine.

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 171-179, 1967. 9 p, 9 fig, 1 tab, 8 ref.

Descriptors: *Tracers, *Crystalline rocks, *Groundwater movement, *South Carolina, Structural geology, Observation wells, Tritium, Radioisotopes, Radioactivity techniques, Radioactive wastes, Waste storage, Fractures (Geology),

Identifiers: *Savannah River, Groundwater velocity, Schist, Gneiss.

The storage of high-level radioactive wastes in unlined tunnels excavated in crystalline rock about 1500 feet beneath the surface was found to be technically feasible at the Savannah River Plant, South Carolina. Most of the crystalline rock consists of schist and gneiss and is nearly impermeable. with very few fractures. Estimates of the natural groundwater velocity were 0.5 ft/yr in nearly im-permeable rock and 5.4 ft/yr for zones of more open fractures. The validity of these hydraulic estiopen tractures. The validity of these hydraulic estimates was tested by using tritium as a tracer and in pumping and swabbing tests in observation wells. The peak concentration of tritium was reached in about one year, yielding an average groundwater velocity of 1,760 ft/yr. The predicted average velocity for the tracer was 320 ft/yr which is 2.5 times lower than the measured velocity. (Carstea-W70-03899

SELECTED ANALYTICAL METHODS FOR WELL AND AQUIFER EVALUATION, Illinois State Water Survey Div., Urbana

For primary bibliographic entry see Field 04B. W70-03943

2G. Water in Soils

INFILTRATION INDUCED SOIL INSTABILI-

Massachusetts Univ., Amherst. Dept. of Civil En-

Jonald Dean Adrian.
Groundwater, Vol 8, No 1, p 29-36, Jan-Feb 1970.
8 p, 6 fig, 7 ref. PHS Grant WP-0026 and FWPCA
Grant 17070-DZS.

Descriptors: *Infiltration, *Percolation, *Capillary action, Soil water movement, Model studies, Hydraulic models, Infiltrometers, Permeameters, Hydraulic conductivity, Permeability. Identifiers: Infiltration stability, Soil air movement.

Theoretical analyses predicted and experimental observations confirmed a mechanism by which strong capillary forces hindered instead of helped promote infiltration into soils. Infiltration into an unsaturated soil overlying an impermeable barrier displaces the air from the soil interstices. Unable to escape downward, the air may escape upward in bubbles traveling through large pores, or, if the pores are small and the capillary forces are large, pores are small and the capillary forces are large, the air is compressed between the wetting front and the barrier. This reduces the infiltration rate and may result in an almost stable wetting front. Under certain calculable conditions the air pressure build-up is sufficient to cause rupturing of the soil, forming a cavity. The air-filled cavity breaks the flow passages and percolation ceases through pores terminating in the cavity. Grain size and packing play a role by limiting the capillary pressure build-up and the bubbling pressure. (Knapp-USGS) W70-03648

FIELD MEASUREMENT AND USE OF SOIL-

WATER PROPERTIES, Oklahoma State Univ., Stillwater. J. M. Davidson, L. R. Stone, D. R. Nielsen, and M. E. LaRue.

Water Resources Research, Vol 5, No 6, p 1312-1321, Dec 1969. 10 p, 16 fig, 4 tab, 15 ref.

Descriptors: *Soil water movement, *Hydraulic conductivity, *Moisture content, *Hysteresis, Onsite tests, Mathematical studies, Darcy's law, Drainage, Capillary action, Capillary conductivity. Identifiers: Hydraulic conductivity-water content

The hydraulic conductivity versus soil-water con-tent relation for different soil depths was measured in the field for three soil profiles. The soils varied in physical properties from homogeneous to heterogeneous with depth and from loamy sand to silty clay in surface soil texture. Hydraulic conductivity values calculated from drainage data taken during different time intervals compared favorable with each other and showed no measurable. with each other and showed no measurable hysteresis. The soil-water flux at various soil depths with and without evaporation at the soil surface was measured. The rate at which water drained from each of the profiles was predicted using Dar-cy's equation and some simplifying assumptions. The agreement between theoretical and measured results is discussed in terms of soil heterogeneity with depth. (Knapp-USGS) W70-03675

DESIGN OF A NEUTRON SCATTERING WATER CONTENT GAGE FOR SOILS, Illinois Univ., Urbana.

For primary bibliographic entry see Field 07B.

DOWNWARD MOVEMENT OF SOIL MOISTURE TRACED BY MEANS OF HYDROGEN ISOTOPES,

Heidelberg Univ. (West Germany). Physics Inst., C-14 Lab.

U. Zimmermann, K. O. Munnich, and W. Roether. G. Zhinierinani, K. O. Wulnich, allu W. Acchel. In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 28-36, 1967. 9 p, 5 fig, 1 tab,

Descriptors: *Soil moisture, *Soil water movement, *Deuterium, *Tracers, Hydraulic gradient, Permeability, Analytical techniques, Evapotranspiration, Groundwater recharge, Hy water, Hydrologic budget, Water balance Hygroscopic

Identifiers: *Downward soil moisture movement. Labeled water.

Experiments using deuterium confirmed the layered movement of soil moisture. Surfaces of 4 sq meters representing two German soils were 'rained with about 5 mm of water containing 1.5% deuterium oxide. Soil samples were collected periodically to trace the downward movement of the labeled water. This labeled layer had a distinguishable boundary between the older and younger rainwater in soil. The water supply and not the hydraulic gradient and permeability is the limiting factor of water movement in unsaturated soils. The following systematic errors are listed and briefly discussed: (1) the depth of water movement may vary according to soil irregularities; (2) tagged water may be bypassed in both directions; (3) the standard moisture determination does not take into account the very strongly bound water which may be capable of isotopic exchange. Isotope tracing provides a method to calculate a balance between the amount of rainfall after the date of tagging and the fraction of this rain that is still present in soil. The difference is considered to be lost by evapotranspiration. (Carstea-USGS) W70-03689

YIELD-PROTEIN RELATIONSHIPS IN WHEAT GRAIN, AS AFFECTED BY NITROGEN AND WATER,

Nebraska Univ., Lincoln. G. L. Terman, R. E. Ramig, A. F. Dreier, and R. A. Olson.

Agronomy Journal, Vol 61, No 5, p 755-759, Sept-Oct 1969. 6 fig, 17 ref.

Descriptors: *Crop production, *Moisture availa-Descriptors: "Crop production," Mostate arana bility, *Nitrogen, *Plant growth, *Proteins, Semiarid climates, Wheat, Moisture stress, Irrigation, Dry farming, Water, Nebraska, Soil moisture, Soil-water-plant relationships, Crop response.

The effect of applied nitrogen on wheat yield and protein under different moisture conditions was tested in semiarid Nebraska. Applied nitrogen increased total yield if adequate soil moisture was available. Under dryland farming conditions where the wheat was subject to severe moisture stress, there was little or no increase in yield but there was a significant increase in protein content. In general percentage of protein decreased as yields increased, but the level of protein at the different yield rates was increased with adequate irrigation. Moisture supply appeared to be the chief factor determining response to applied nitrogen. (Crouse-Arizona) W70-03800

SOIL RESPIRATORY ACTIVITY AND ORGANIC MATTER DEPLETION IN AN ARID NEVADA SOIL, Nevada Univ., Reno.

S. D. Lyda, and G. D. Robinson. Soil Science Society of America, Proceedings, Vol 33, No 1, p 92-94, 1969. 1 tab, 3 fig, 12 ref.

Descriptors: *Soil treatment, *Respiration, *Soil microorganisms, *Organic matter, *Arid lands, Nevada, Microenvironment, Metabolism, Oxygen requirements, Sudangrass, Oats, Alfalfa, Soil amendments, Manometers, Oxygen, On-site investigations, Soil environment, Sampling. Identifiers: *Crop residues.

High correlations have been observed between soil respiratory activity and actual microbial counts.

During a 4 year period mature crop residues of alfalfa, oats, and sudan have been incorporated in an irrigated sandy loam in arid southern Nevada in an attempt to reduce Phymatotrichum root rot. This paper presents the results of this operation in the field for 2 years as well as supporting laboratory studies of the same residues at various amendment rates. In the field a close relationship was noted between respiration rate and organic matter content which decreased slowly over a 6-month period. In the laboratory the same residues were added at the 1, 2, 3, and 4% by weight levels. Maximum activity was noted during the first 2 weeks for the 2, 3, and 4% levels. Respiration rate was proportional to residue concentration. However, increments were not additive. The results suggest that a given soil could become saturated with organic matter and at that point other factors would become limiting on respiration, such as available oxygen or accumula-tion of metabolic products. (Crouse-Arizona) W70-03801

ROOTZONE SALT PROFILES AND ALFALFA GROWTH AS INFLUENCED BY IRRIGATION WATER SALINITY AND LEACHING FRAC-

Agricultural Research Service, Riverside, Calif. Soil and Water Conservation Research Div.; and Agricultural Research Service, Riverside, Calif. Salinity Lab.

C. A. Bower, G. Ogata, and J. M. Tucker. Agronomy Journal Vol 61, No 5, p 783-785, Sept-Oct 1969. 1 tab, 3 fig, 2 ref.

Descriptors: *Arid lands, *Irrigation water, *Drainage water, *Saline water, *Plant growth, Saline soils, Lysimeters, Alfalfa, California, Root zone, Soil-water-plant relationships.

Alfalfa was grown in 24 lysimeters at Riverside, California, with 12 irrigation water salinity and leaching fraction treatments. Plant yield was related to the salinity that developed in the root zone. The first increments of leaching were most effective in preventing salt accumulation in the soil. At high leaching fractions much of the water applied beyond that required for evapotranspiration was of little effect in lowering soil salinity. (Crouse-Arizona) W70-03807

VAPOR LOSSES THROUGH SOIL MULCH AT DIFFERENT WIND VELOCITIES,

Punjab Agricultural Univ., Hissar (India). Dept. of

C. L. Acharya, and S. S. Prihar. Agronomy Journal, Vol 61, No 5, p 666-669, Sept-Oct 1969. 3 tab, 3 fig, 6 ref.

Descriptors: *Mulching, *Evaporation control, *Porosity, *Water vapor, *Wind velocity, Soil moisture, Evaporation, Laboratory tests, Soil physical properties, Vapor pressure, Arid lands. Identifiers: *India, Mulch porosity, Mulch thickness (Vaporales) thickness, Vapor loss.

When intervals between irrigations are long, the soil surface dries and a large proportion of moisture loss occurs in vapor form through the dry surface layer. The authors report a laboratory study to determine rate of vapor losses with different wind velocities and mulch porosities. The soil was a sandy loam and the mulch was prepared from a sandy loam treated with water repellent polyvinyl alcohol. The ratio of evaporation through a dry layer to that from a continuously wet surface was a function of the thickness of the dry layer over a cer-

Group 2G-Water in Soils

tain range. Within this range the vapor loss could be expressed with a regression equation as a function of wind velocity and porosity of the mulch. (Crouse-Arizona) W70-03808

RUNOFF INDUCEMENT IN ARID LANDS,

National and Univ. Inst of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research. For primary bibliographic entry see Field 03B. W70-03809

SOIL FACTORS INFLUENCING PERCOLA-TION TEST PERFORMANCE,

Pennsylvania State Univ., University Park. Dept. of Soil Science

B. D. Derr, R. P. Matelski, and G. W. Petersen. Soil Science Society America Proceedings, Vol 33, No 6, p 942-946, Nov-Dec 1969. 5 p, 5 tab, 19 ref.

Descriptors: *Soil water movement, *Percolation, Statistical methods, Percolating water, Soil environment, Clays, Silts, Soil texture, Slopes,

Identifiers: Drainage classes, Fragipans, Subsoil consistence, Percolation tests.

Percolation rates were measured at 250 sites in Pennsylvania. Statistical analysis of the data showed that there was considerable variation between percolation test rates within sites. The variability of individual tests between sites on the same soil series is generally greater than the variability of individual tests within sites. The clay contents and drainage classes were negatively correlated. The silt content and coarse fragments of the subsoil were positively correlated. Drainage classes, fragipans, subsoil texture, surface coarse fragments, type and grade of subsoil structure, parent material, and slope classes were significantly related to percolation rates. Moderately well, somewhat poorly, and poorly drained soils were influenced by moist subsoil consistence, fragipans, subsoil structure grade, and subsoil texture. Soil drainage classes are closely related to percolation rates. (Carstea-USGS) W70-03850

NUMERICAL METHOD FOR ESTIMATING SIMULATANEOUS FLOW OF WATER AND SALT IN UNSATURATED SOILS, Colorado State Univ., Fort Collins. Dept. of Soil Sciences; and Utah State Univ., Logan. Dept. of Soils and Meteorology.

E. Bresler, and R. J. Hanks.

Soil Science Society America Proceedings, Vol 33, No 6, p 827-832, Nov-Dec 1969. 6 p, 5 fig, 13 ref. OWRR Project B-008-COLO.

Descriptors: *Unsaturated flow, *Model studies, *Soil water movement, Numerical analysis, Mathematical studies, Saline soils, Infiltration, Evaporation, Water distribution (Applied), Diffusion, Ion exchange, Fertilizers, Herbicides, Pesticides, Water chemistry. Identifiers: Unsaturated soils, Salt distribution.

A numerical solution of noninteracting salt flow simultaneously with water in unsaturated soil was devised and programmed. Solutions were obtained devised and programmed. Solutions were obtained for infiltration, redistribution, and evaporation under different wetting and boundary conditions. The effect of diffusion on salt distribution was neglected in the computations. The method was found to give reasonable results for noninteracting solutes. When compared with measured total salt distribution after one wetting and drying cycle, the model gave fairly good results when a source term was added to the computations. The method can be applied to some practical problems, such as leaching of salts and fertilizer movement. (Carstea-USGS)
W70-03851

INFILTRATION, REDISTRIBUTION, AND SUB-SEQUENT EVAPORATION OF WATER FROM SOIL AS AFFECTED BY WETTING RATE AND HYSTERESIS,

Colorado State Univ., Fort Collins. Dept. of Soil Science; and Utah State Univ., Logan. Dept. of

Soils and Meteorology.

E. Bresler, W. D. Kemper, and R. J. Hanks. Soil Science Society America Proceedings, Vol 33, No 6, p 832-840, Nov-Dec 1969. 9 p, 10 fig, 1 tab, 15 ref. OWRR Project B-008-COLO.

Descriptors: *Soil water movement, *Water transfer, *Soils, Columns, Infiltration, Wetting, Evaporation, Hysteresis, Flow, Moisture content. Identifiers: *Soil columns, Water suction.

Soil columns were wetted at three different rates which caused unequal water content profiles during infiltration. Hysteresis in soil water contentwater suction relationships has a larger effect on water redistribution as the wetting rate increases. The effect tends to keep the water content higher and the zone of wetting shallower during the redistribution stage when rates of wetting are faster. At any given redistribution time, higher water content and lower wetting depth cause the subsequent evaporation to be greater. Evaporation was directly related to the previous wetting rates. The experimental results are in agreement with the results of numerical solution to water flow equations. (Carstea-USGS) W70-03852

COMPARISON OF COMPUTED AND MEASURED MOISTURE REDISTRIBUTION FOL-LOWING INFILTRATION,
Department of Agriculture, Ottawa (Ontario). Soil

Soil Science Society America Proceedings, Vol 33, No 6, p 840-847, Nov-Dec 1969. 8 p, 10 fig, 1 tab,

Descriptors: *Moisture content, *Soil water movement, *Infiltration, Particle size, Hydraulic conductivity, Hysteresis, Soils, Diffusivity. Identifiers: Water-holding capacity, Tension curves, Soil water redistribution.

Redistribution of water was measured in three soils following two different initial amounts of infiltration. The measured redistribution profiles were compared with those computed from the flow equation taking into account hysteresis in the drying tension vs water content relationship. Agreement between measured and computed moisture profiles was considered satisfactory. A procedure was outlined for determining wetting diffusivities and conductivities in the wetting front on the basis of soil moisture profiles obtained during redistribution. The different shapes of the drying scanning tension curves provided some insight into the differences in particle size distribution that influence the water-holding capacity of soils. (Carstea-USGS) W70-03853

THERMO-OSMOSIS THROUGH COMPACTED SATURATED CLAY MEMBRANES, Gulf Research and Development Co., Pittsburgh,

Pa. C. Dirksen.

Soil Science Society America Proceedings, Vol 33, No 6, p 821-826, Nov-Dec 1969. 6 p, 1 fig, 5 tab, 26 ref.

Descriptors: *Osmosis, *Membranes, *Soil water movement, *Water chemistry, Permeability, Hydraulic properties, Kaolinite, Bentonite, Sodium, Temperature, Flow, Unsaturated flow, Clays. Identifiers: *Clay membranes, Thermo-osmosis, Na-kaolinite, Na-bentonite.

Hydraulic permeability of saturated Na-kaolinite decreased more rapidly with increasing compaction pressure than did thermo-osmotic permeabili-

ty. This resulted in a moderate increase of thermoosmotic pressure difference. Sodium bentonite showed a decrease in the thermo-osmotic pressure difference at a compaction pressure of 7.0 kg/sq cm. At the same time, the thermo-osmotic permiability increased with increasing average temperature. Thermal flow of water occurred from the warm to the cold side and was generally less than that reported for liquid water in unsaturated solids. The apparent activation energy of thermo-osmotic water transport in Na-bentonite was estimated to be about 29 cal/g water; the heat of transport was more than 3 orders of magnitude smaller. (Carstea-W70-03859

INFILTRATION RATES AS AFFECTED BY DESERT VEGETATION, Arizona Univ., Tucson. Forest P. Lyford, and Hasan K. Qashu. Water Resources Research, Vol 5, No 6, p 1373-1376, Dec 1969. 4 p, 3 fig, 3 tab, 4 ref. OWRR Project A-012-ARIZ.

Descriptors: *Infiltration, *Vegetation effects, *Arid lands, Soil-water-plant relationships, On-site tests, Soil water movement.
Identifiers: Paloverde, Creosote bush.

Infiltration of water into two soils measured at radial distances from the stems of paloverde (Cercidium microphyllum) and creosote bush (Larrea um inicrophyllum) and creosote bush (Larrea tridentata) were found to average nearly three times greater under plants than in the openings. Bulk density was lower and organic matter content was higher in topsoil under plants than in the openings. (Knapp-USGS) W70-03864

EVALUATION OF FLOW PARAMETERS,

Department of Agriculture, Ottawa (Ontario). Soil

Department of Agriculture, Ottawa (Ontario), Son Research Inst. W. J. Staple. Proceedings of Hydrology Symposium No 6 on Soil Moisture, Saskatchewan University, Nov 15-16, 1967, p 81-100, National Research Council, Ot-tawa, Canada 1968, 20 p, 3 fig, 2 tab, 32 ref.

Descriptors: *Soil water movement, *Flow characteristics, *Unsaturated flow, Hydraulic conductivity, Diffusivity, Soil structure, Bulk density, Hydraulic gradient, Soils, Soil water, Steady flow, Unsteady flow, Boundary processes, Hysteresis. Identifiers: *Flow parameters.

The parameters determining water flow through unsaturated soil are conductivity or diffusivity coefficients. In the simplest situation, when soil moisture tension is a unique function of moisture content, conductivity K and diffusivity D are proportionality factors relating flow rates respectively to hydraulic and moisture content gradients. It follows that K and D may be obtained in flow experiments in which the relevant flow rates and gradients are measured. Conductivity coefficients vary a million-fold in the soil moisture range of ingradients are measured. Conductivity coefficients vary a million-fold in the soil moisture range of interest to hydrologists. No one experimental arrangement is adequate to obtain K for the whole moisture range. Indirect determinations involving diffusivity have been used to extend the data to drier soils, but for some moisture contents satisfactory methods are not yet available. In some cases, improved conductivity data may be inferred in comparing trial computations of moisture movement with experimentally determined moisture profiles. (Carstea-USGS)

MECHANICS OF THE MOVEMENT OF MOISTURE AND CHEMICAL SUBSTANCES IN

SOILS, Guelph Univ. (Ontario). Dept. of Soil Science.
D. E. Elrick, and J. H. M. Aalders.
Proceedings of Hydrology Symposium No 6 on Soil Moisture, Saskatchewan University, Nov 15-16, 1967, p 51-79, National Research Council, Ottawa, Canada, 1968. 29 p, 3 fig, 2 tab, 32 ref.

Descriptors: *Soil water movement, *Dissolved solids, *Saturated flow, *Unsaturated flow, Water vapor, Diffusion, Air circulation, Convection, Interfaces, Osmotic pressure, Percolation, Chemical potential, Adsorption.

Identifiers: Matric potential, Osmotic potential, Gravitational potential.

There are 3 groups of forces acting on soil water, namely, matric, osmotic and body forces. A brief description of these forces is given. Isothermal liquid and vapor flow theory is applied to soil moisture movement. Movement of water through both saturated and unsaturated zones is influenced by various potentials such as matric, gravitational, pressure, adsorption, and chemical. Substances dissolved in soil water or present in soil air can move by diffusion or by a combination of diffusion and convection. An analysis of the transport processes of chemical substances in the liquid or vapor phase of chemical substances in the liquid or vapor phase is included. The interactions taking place at the solid-liquid interface can complicate the overall transport of water and chemical substances. (Carstea-USGS)
W70-03881

ELECTRICAL ANALOGUES AND DIGITAL COMPUTERS FOR ESTIMATING UNSATURATED WATER FLOW IN SOILS, Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div.

R. J. Hanks.

Proceedings of Hydrology Symposium No 6 on Soil Moisture, Saskatchewan University, Nov 15-16, 1967, p 119-131, National Research Council, Ot-tawa, Canada, 1968. 13 p, 6 fig, 19 ref.

Descriptors: *Soil water movement, *Analog models, *Digital computers, Soil moisture, Computers, Unsaturated flow, Diffusivity, Dimensional analysis, Soils, Model studies, Analog computers, Computer models.

Identifiers: Hydrologic model studies.

Many complex problems related to water flow through soils may be solved by using electrical analogs and digital computers. Where diffusivity is a constant, solution of unsaturated water flow soils is very convenient. Analog models are quite inexpensive. Variables can be easily changed and inexpensive. Variables can be easily changed and solutions obtained quickly. Analog models are good training tools. The main disadvantages of analogs are: (1) They are limited to the solution of special problems and (2) the solutions are not as accurate as those obtained with digital computers. For one-dimensional flow, the digital computers allow for solution of almost any problem that can be formulated. (Carstea-USGS)

SIMILITUDE FOR PARTIALLY SATURATED FLOW SYSTEMS,

Department of Agriculture, Lethbridge (Alberta). Research Station.

Research Station.
G. E. Laliberte, A. T. Corey, R. H. Brooks, G. L.
Corey, and D. B. McWhorter.
Proceedings of Hydrology Symposium No 6 on Soil
Moisture, Saskatchewan University, Nov 15-16,
1967, p 101-118, National Research Council, Ottawa, Canada, 1968. 18 p, 3 fig, 22 ref.

Descriptors: *Unsaturated flow, *Mathematical models, *Hydraulic models, *Soil water movement, Hydrologic properties, Unsteady flow, Steady flow, Soils, Boundary processes, Hysteresis, Dimensional analysis.
Identifiers: Partially saturated flow.

The use of mathematical and hydraulic models to solve hydrological problems is reviewed. When mathematical approaches cannot provide solutions for physical phenomena, the use of mathematical and hydraulic models may prove useful in understanding these phenomena. Similitude theory was verified in the laboratory for modeling steady and transient flow of two immiscible fluids in saturated and prestidily extracted acid systems. Marched rated and partially saturated soil systems. More research is necessary to find solutions of such

problems as boundary effects, medium-fluid interactions, entrapped air, and hysteresis. (Carstea-USGS) W70-03883

THE EFFECT OF SOIL MOISTURE ON INFILTRATION AS RELATED TO RUNOFF AND RECHARGE,

Saskatchewan Univ., Saskatoon. Dept. of Agricul-

tural Engineering.
Don M. Gray, and D. I. Norum.

Proceedings of Hydrology Symposium No 6 on Soil Moisture, Saskatchewan University, Nov 15-16, 1967, p 133-153, National Research Council, Ottawa, Canada, 1968. 21 p, 6 fig, 1 tab, 25 ref.

*Soil moisture, *Groundwater recharge, *Surface runoff, *Surface-groundwater relationships, Capillary action, Gravitational water, Moisture content, Watersheds (Basins), Capillary conductivity, Moisture tension. Soils

Identifiers: Capillary conductivity-moisture content curves, Moisture-tension relationships.

In the infiltration process, water enters the soil surface under the combined influences of gravity and capillary forces. The rate of infiltration may be governed by two separate processes: (1) Entry of water through the surface layer and (2) downward movement or percolation of water through the soil profile. The effects of soil moisture on moisture profiles and infiltration rate, the effect of soil moisture gradient, and the interrelationships of soil moisture and other factors influencing infiltration are briefly discussed. Increasing the initial soil moisture content increases the velocity at which the wetting front moves but decreases the infiltration rate. The initial moisture content of the soil affects the shape of the moisture distribution profile. The infiltration potential for soils in a watershed could be evaluated from soil moisture measurements such as: (1) The capillary conductivitymoisture content curve; (2) the moisture-tension relationship, and (3) an experimental relation between the soil moisture content and infiltration rate. Infiltration in frozen and unfrozen soils is also discussed. (Carstea-USGS) W70-03884

RELATIONSHIPS BETWEEN SOIL MOISTURE ACTUAL AND POTENTIAL EVAPOTRANS-PIRATION,

Department of Agriculture, Ottawa (Ontario). Plant Research Inst.

For primary bibliographic entry see Field 02D. W70-03885

FRACTIONATION OF TRITIUM AND DEUTERIUM IN SOIL WATER, Geological Survey, Washington, D.C.

Gordon L. Stewart.

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 159-168, 1967. 10 p, 1 fig, 8 tab, 5 ref.

Descriptors: *Radioactive dating, *Tracers, *Deuterium, *Tritium, *Distillation, Soil moisture, Clays, Tracking techniques, Ion exchange, Diffusion, Kaolinite, Montmorillonite, Groundwater movement, Surface waters, Sands.

Identifiers: *Tritium fractionation, *Deuterium fractionation, Isotopic exchange.

Laboratory investigations are being conducted to determine the potential capabilities of hydrogen isotopes in age-dating techniques and as tracers for ground and surface waters. Preliminary results show that tritium and deuterium interact with clay minerals as water diffuses through Davidson clay. The data suggest that two stages characterize this interaction with clay minerals: a rapid exchange with more labile hydroxyl groups, followed by exchange with other structural hydroxyls. The initial and rapid exchange was characteristic, but to varying degrees, of all clay minerals used in this investigation. Except for tritium in Davidson clay, the data were not sufficient to show that additional exchange occurs beyond the first stage. The data suggest that isotopic exchange and fractionation of hydrogen isotopes in the clay-water system may be significant for some age-dating and water-tracing investigations where water flow is slow through some kinds of clays. For many investigations, how-ever, this isotope effect is not important, because it is small compared with accuracies required of the as small compared with accuracies required of the data. As the tracer art progresses, it will become possible to apply isotope effect corrections to the data. (Carstea-USGS) W70-03897

2H. Lakes

'SALT-BISCUITS' - A SPECIAL GROWTH STRUCTURE OF NaCI IN SALT SEDIMENTS OF THE TUZ GOLU ('SALT LAKE'), TURKEY, Heidelberg Univ. (West Germany). Sediment Research Lab.

For primary bibliographic entry see Field 02K. W70-03671

ULTRA-LOW VELOCITY MEASUREMENT IN A STRATIFIED RESERVOIR BY ISOTOPIC CURRENT METER,

Tennessee Valley Authority, Norris. Engineering

Rex A. Elder, and Svein Vigander. In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 81-84, 1967. 4 p, 4 fig.

Descriptors: *Thermal stratification, *Radioactivity techniques, *Radioisotopes, *Reservoirs, *Tracers, Velocity, Iodine radioisotopes, Instrumentation, Current meters, Stratified flow, Flowmeters, Flow measurement, Flow rates.
Identifiers: *Fontana Reservoir, Isotopic current

Field water velocity measurement techniques used in TVA's Fontana Reservoir are described. Thermal density stratification of a uniformly varying type occurs in this reservoir and results in the withdrawal occurring from a discrete layer rather than through the full depth. The velocities, which are in the neighborhood of from 0 to 0.10 ft/sec, are measured by means of an instrument that uses radioactive iodine as a tracer. This meter was developed by the Atomic Energy Commission's Division of Isotopic Development and is termed DWICA-1, for Deep Water Isotopic Current Analyzer. The instrument also measures the current direction. Use of the described technique permits in situ flow studies in thermally stratified reservoirs where very low relocities could hardly be made previously. (Carstea-USGS) W70-03697

RESULTS OF LIMNOLOGICAL INVESTIGA-TIONS ON THE VALLEY RESERVOIRS IN THE MORAVA RIVER BASIN, Brno Univ. (Czechoslovakia).

Milos Zelinka.

Acta sc nat Brno, 2 (12): 1-40, 1968. 24 tab, 3 fig,

Descriptors: *Reservoirs, Water quality, Temperature, Water utilization, Water resources, Water supply, Water development, Epilimnion, Hypolimnion, Bioindicators, Biological properties, Physiochemical properties, Irrigation, Recreation, Fishing.
Identifiers: Czechoslovakian reservoirs, Forecast of

water quality.

The results of limnological investigations carried out in 1952-1964 on the valley reservoirs in the Morava River Basin (Czech.) are presented. Tables of average results indicate both the basic characteristic forms. teristics of water composition and the flows in

Group 2H-Lakes

former investigations. The influence of temperature of water on the development of biological conditions and the exploitation rates of water (watersupply, irrigation, fish breeding) is discussed. The problem of evaluation and prognosis of water quality in newly constructed reservoirs is discussed. The reference includes reports of the Research Institute of Water Management in Brno (Czech.), sum-marizing data ascertained by investigations on the valley reservoirs in the Morava River Basin. A complete list of publications dealing with limnology of these reservoirs is also presented. (Novotny-Vanderbilt) W70-03715

BACTERIAL POPULATION OF HUMIFIED LAKES (IN RUSSIAN),
Akademiya Nauk SSSR, Leningrad. Zoologicheskii

Institut.

A. G. Rodina.

Mikrobiologiya, Vol 38, No 3, p 531-537, May-June 1969. 2 fig, 7 tab, 17 ref.

Descriptors: *Bacteria, *Population, *Lakes, *Dystrophic, Biological communities, Eutrophication, Oligotrophy, Yeasts, Azotobacter, Sulfur, Detritus, Surfaces, Actinomycetes, Iron, Productivity, Humic acids, Calcium, Hydrogen ion con-centration, Color, Magnesium, Chemistry, Temperature, Carbon dioxide, Oxygen, Biochemical oxygen demand, Silica, Nitrogen, Organic matter, Depth, Bottom sediments, Hydrogen sulfide, Humus, Pseudomonas, Pigments, Beggiatoa, Clostridi-

um.
Identifiers: *Humification, Lake Ladoga region (USSR), Mineralization, Spirilla, Physiological groups, Caulobacter, Rhodomicrobium vanielli, Thiothrix, Thiopedia, Chromatium, Rhabdochromatium, Beggiatoa alba.

The number of bacterial plankton in humified lakes of differing degrees of humification varies within wide limits: it is lower than in eutrophic lakes but appreciably higher than in oligotrophic lakes. Changes in water chemistry and bottom deposits, and especially the establishment of an acid pH, create special conditions in a humified lake for the cycle of matter, for the development of life in general, and for development of bacteria in par-ticular. Low mineralization of water and acid pH assist the development of special bacterial associaassist the development of special pacterial associa-tions and changes in bacterial populations, consist-ing of various physiological groups. Nonsporeform-ing rods predominate, the ratio of rods to cocci is quite close in all lakes. Sporeforming bacteria require a higher concentration of nutrients whereas many nonsporeforming bacteria extract nutrients from diluted solutions. The cenoses composition of humified lakes consists of many yeasts, filamentous forms and azotobacter-like cells in the bottom norms and azotobacter-like cells in the bottom water layers, in the pelogen, and various sulfur bacteria on detritus particles and in surface layers of water. Actinomycetes was noted in Lake Naryadnoe and heterotrophic iron bacteria in Lake Solovienskoe, USSR. (Jones-Wisconsin) W70-03948

AVAILABILITY OF MUD PHOSPHATES FOR

THE GROWTH OF ALGAE,
For primary bibliographic entry see Field 05C.
W70-03955

CONCEPTS OF EUTROPHICATION AND TROPHIC BIOLOGY,
Oesterreichische Akademie der Wissenschaften, Vienna, Lunz Biological Station.

Franz Ruttner

Fundamentals of Limnology, University of Toronto Press, p 130-131, 159-165, 1963. 2 fig.

Descriptors: *Lakes, *Eutrophication, *Biomass, Descriptors: "Lakes, "Eutrophication, Dolliass, "Productivity, Cyanophyta, Nuisance algae, Limnology, Chlorophyta, Plankton, Phytoplankton, Water pollution effects, Wisconsin Zooplankton, Tripton, Nannoplankton, Nutrients, Oligotrophy, Transcrupe, Light-Intensity, Danhia, Connect Temperature, Light intensity, Daphnia, Connecticut, Rotifers.

*Trophic *Concepts, hiology. Identifiers: Anabaena flos aquae, Aphanizomenon flos aquae, Glocotrichia echinulata, Botryococcus, Plankton distribution, Wisconsin Lake Survey, Nitrogen con-tent, Lake Erken (Sweden), Lake Mendota (Wis), Net plankton, Chlorophyll content, Centrifuge method, Calculated volume method, Cyclotella comensis, Rhodomonas lacustris, Enotomostraca, Diaptomids, Bosmina, Carinthia, Sunda Islands.

This standard textbook of limnology includes a discussion of concepts pertaining to eutrophication and trophic ecology of lakes. Mechanical factors influencing plankton distribution include density of water and plankton, differential water viscosity, and turbulent eddy diffusion currents. The following describes formation of nuisance blooms, 'In calm weather the blue-green algae of the plankton rise to the surface in consequence of their 'gas vacuoles' and there aggregate into thick masses, often forming a 'water bloom' recognizable from afar by its blue-green coloration. Anabaena flos aquae and Aphanizomenon flos aquae reveal by their names that they belong to the group of algae that can produce this striking phenomenon.' Based upon a composite definition by others, production can be considered as the total amount of organic matter, representing balance between assimilation and dissimilation, which forms in a defined period from raw materials supplied. Standing crop is defined as the instantaneous living population. Fertility is the average biomass of a unit volume of water within the trophogenic zone, and is governed by limiting nutrients, their conversion to organic matter occurring in proportion to temperature and illumination. Discussion includes a critique of techniques for determination of planktonic biomass. (Eichhorn-Wisconsin)

THE MYXOBACTERIA TYPE QUOTIENT AS AN INDICATOR OF EUTROPHICATION FOR SURFACE WATERS (IN GERMAN),

Erlangen-Nuremberg Univ. (West Germany). Hygienisch-Bakteriologischen Institut.
W. Graf, and P. Sturzenhofecker.
Archiv fur Hygiene und Bakteriologie, Vol 149, No 3/4, p 265-273, 1965. 2 fig, 4 tab, 13 ref.

Descriptors: *Eutrophication, *Myxobacteria, Descriptors: *Eutrophication, *Myxobacteria, *Surface waters, *Indicators, Biochemistry, Ecology, Plankton, Oxygen, Organic matter, Nitrogen, Phosphorus, Calcium, Hydrogen ion concentration, Color, Mud, Catalysis, Pigments, Depth, Fish, Zooplankton, Sewage, Beaches, Sampling, Carbon

Identifiers: *Sporocytophaga cauliformis, Uberlinger See (Germany), Biosphere, Trans-Identifiers: Oberlinger See (Germany), Biosphere, Iransparency, Catalases, Swarming characteristic, Walchensee (Germany), Kochelsee (Germany), Antibiotic activities.

Aquatic mysobacteria, Sporocytophaga cauliformis, are common in surface waters. They are separable into two types, based on their biochemi-cal properties: Type I can split sugar aided by acid without gas formation and shows strong catalase formation; Type II cannot form sugar from acid and shows a weak catalase activity. An extensive survey of their relative occurrence showed great dif-75%; Type II increased in eutrophic waters. Research shows them as a microbiological indicator of trophication of surface waters. The ability to form catalases is the distinguishing characteristic of the types. A direct relationship between the eutrophication state and the type quotient exists with oxygen content a criterion for type distribution. Type I occurs in oxygen-rich media on the basis of its heavy catalase activity, whereas Type II, on the basis of its low ability to form catalases, grows in an oxygen-poor environment. In assuming that these differences also apply to growth in open water, we obtain direct relationships between the ecology of both types and the oxygen content of the corresponding biotope. (Jones-Wisconsin) W70-03963

RX FOR AILING LAKES -- A LOW PHOSPHATE

International Joint Commission-United States and Canada

Environmental Science and Technology, Vol 3, No 12, p 1243-1245, 1969. 2 fig.

Descriptors: *Phosphates, *Lakes, *Detergents, *Tertiary treatment, *Great Lakes, Control, Costs, Eutrophication, Nitrates, Lake Erie, Lake Ontario, Oligotrophy, Pollution abatement, Pollution abatement, Oligotrophy, Depth, Phytoplankton, Zooplankton, Physicochemical properties, Domestic wastes, Sewage, Industrial wastes, Agriculture, St Lawrence River, Algae, Coliforms, Dissolved oxygen, Dissolved solids, Temperature, Color, Taste, Hydrogen ion concentration, Iron, Radioactivity.

Identifiers: Canada, Mesotrophy, Lake Norrviken, Lake Mendota, Lake Fures, Lake Sebasticook, Lake Washington, Lake Malaren, Lake Annecy, Lake Vanern, Lake Constance, Pfaffikersee, Turlersee, Baldeggersee, Greifensee, Zurichsee, Moses Lake, Hallwillersee.

Study was initiated in 1964 when the International Joint Commission of the U S and Canada established advisory groups on status of pollution in Lakes Erie and Ontario and segments of the St Lawrence River. Report recommends technical and legislative machinery for control measures. Detergents' phosphate content should be reduced immediately to minimum practical levels, with complete replacement of phosphorus with less in-nocuous substances no later than 1972. 80% removal of phosphates from all effuents should be effected by 1972 in the Lake Erie basin and by 1975 in Lake Ontario. Treatment of waste effluents for phosphate removal must be in addition to, not a substitute for detergent reformulation. Phosphorus and nitrogen are recognized as the major nutrients responsible for eutrophication; it is apparent that phosphate is the controlling factor in enrichment of lower Great Lakes. Efficient and relatively inexpensive methods are available for 80-95% removal of phosphorus during sewage treatment, whereas comparable elimination of nitrogen compounds is not yet feasible. Costs for phosphate removal at treatment plants would be reduced by one-half to two-thirds with replacement of phosphate detergent builders. (Jones-Wisconsin) W70-03964

NITROGEN METABOLISM IN LAKES. I. MEA-SUREMENT OF NITROGEN FIXATION WITH

N-15, Wisconsin Univ., Madison. Dept. of Zoology; and Pittsburgh Univ., Pa. Dept. of Zoological Sciences. John C. Neess, Richard C. Dugdale, Vera A.

Dugdale, and John J. Goering. Limnology and Oceanography, Vol 7, p 163-169, 1962. 3 fig, 1 tab, 10 ref.

Descriptors: *Nitrogen fixation, *Metabolism, *Lakes, *Analytical techniques, Nitrogen cycle, Wisconsin, Pennsylvania.
Identifiers: *Nitrogen-15, Mass spectrometry, Isotope ratios, Heavy nitrogen, Nitrogen (Kjeldahl), Isotope-ratio mass spectrometers, Lake Wingra (Wis), Lake Mendota (Wis), Pittsburgh (Pa), Error analysis.

Heavy nitrogen (N-15) has been successfully used in studies of nitrogen metabolism in organisms and of biological nitrogen fixation. A method is described for measuring rates of nitrogen fixation in lake water samples using N-15 as a tracer, and subsequent determination of isotope ratio by mass subsequent determination of isotope ratio by mass spectrometry of nitrogen fixed during incubation of sample. Details of gassing manifold, including special glassware, are described, as are procedures and reagents. Rates of nitrogen fixation can be calculated from a knowledge of Kjeldahl-nitrogen, determined after incubation, and of isotope enrichment of both starting nitrogen gas and the fixed sample. Selection of proper standards is crucial for accurate determination of aton % excess N-15 in fixed sample. Statistical comparisons of a series of blacks. sample. Statistical comparisons of a series of blanks

and standards with a single bulb of compressed, water-pumped nitrogen gas--used as a primary standard--indicated that routine controls are not required and that ammonium sulfate is an adequate secondary standard. Probable sources of error include use of reduced nitrogen-pressure in incubation vessel, length of incubation, and incorporation of label into nitrate or nitrite (lost to the Kjeldahl determination). These errors are negligible in the procedure described. (Eichhorn-Wisconsin) W70-03970

ONONDAGA LAKE, NEW YORK--A UNUSUAL ALGAL ENVIRONMENT, Syracuse Univ., N. Y. Dept. of Civil Engineering. YORK--AN

For primary bibliographic entry see Field 05C.

EVIDENCE FOR EUTROPHICATION FROM REMAINS OF ORGANISMS IN SEDIMENTS,

Indiana Univ., Bloomington. Dept. of Zoology. David G. Frey.

Eutrophication: Causes, Consequences, Correctives. Proceedings of a Symposium, National Academy of Sciences, Washington, DC, p 594-613, 1969. 8 fig, 28 ref.

Descriptors: *Eutropmicauon;
Paleolimnology, Biochemistry, Algae, Cyanophyta,
Mineralogy, Aquatic animals, Stratigraphy, Pollen,
Diatoms Meromixis, Carbon *Eutrophication, Spores, Diatoms, Meromixis, Carbon radioisotopes, Ecology, Silica, Epilimnion, Daphnia, Hypolimnion. Sewage effluents. Nutrients, Clays, Sedimentation rates, Oligotrophy, Glaciation.

Identifiers: *Remains, *Organisms, Fossils, Morphological fragments, Carotenoids, Cladocera, Langsee, Esthwaite water, Lago di Monterosi (Italy), Ambrosia, Community analysis, Zurichsee, Lake Washington, Phacotus, Difflugia, Ceratium, Dinobryon, Staurastrum, Baldeggersee, Oscillatoria, Codonella, Limmat River (Switzerland), Aguada de Santa Ana Vieja (Guatamala), Lake Petenxil (Guatemala), Diversity index, Equitabili-ty, Lake Sebasticook (Maine), Centric diatoms, Araphidineas.

'Remains of organisms' may mean both the biochemical substances produced by organisms or resulting from their degradation, and identifiable morphological fragments. Studies of biochemical fossils and the chemistry and mineralogy of sediments are preferable to studies of morphological reamins, since, with new methods and techniques, a close-interval stratigraphy can be constructed from a core only an inch or two in diameter. The most important morphological remains in freshwater sediments are pollen and spores (chiefly of terrestrial plants), diatom frustules and Cladoceran fragments. Pollen diagrams provide a relative chronology; appearance of Ambrosia pollen grains gives a stratigraphic horizon, dating incidence of man and his modification of regional ecology. Diatom remains reflect composition of producing populations; their assemblages in offshore sediment cores show progressive changes, interpretable in terms of the lakes' history and their relative abundance gives insight inot changes accompany-ing enrichment. Most abundant animal remains in sediments are heads and shells of various Cladocera and new techniques enable us to analyze Cladoceran population responses in greater detail. There are inconclusive indications that quantities of remains may be indicative of past productivity. (See also W70-03975). (Jones-Wisconsin) W70-03977

NUTRIENT SEDIMENT-WATER TERCHANGE,

Federal Water Pollution Control Administration, Corvallis, Oreg. Arnold R. Gahler.

Proceedings of the Eutrophication-Biostimulation Assessment Workship, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 243-257. 6 tab, 20 ref.

Descriptors: *Measurement, *Sediment-water interfaces, Nutrients, Algae, Aquatic plants, Ecosystems, Bacteria, Hydrogen ion concentration, Eutrophication, Suspension, Phosphorus, Phosphates, Nitrogen, Ammonia, Nitrites, Silicates, Nitrates, Conductivity, Oligotrophy, Oregon, California, Minnesota, South Dakota, Dredging, Time, Temperature, Freezing, Storage, Cobalt, Irradiation, Waves (Water), Wind, Fish,

Boating, Gases, Diffusion.
Identifiers: *Interchange, Upper Klamath Lake (Ore), Agency Lake (Ore), Salton Sea (Calif), Selenastrum, Shagawa Lake (Minn), Sallie Lake (Miss), Herman Lake (S Dak), Clear Lake (Calif), Woahink (Ore), Interstitial water, Benthic organisms, Algal growth.

Quantitative measurement of nutrient interchange between sediments and overlying lake water is difficult either by field or laboratory tests. Nutrient availability in lake sediments was determined by analysis of interstitial water from sediments taken from Oregon lakes and others in western United States. Much soluble phosphorus and nitrogen is available for algal growth when sediment is physically mixed with overlying water. In shallow lakes, mixing occurs by resuspension of sediments from wave action, stirring by benthic organisms, fish, boating, gas release, lifting of sediment by algal growths, and diffusion. Cores indicate concentrations of nutrients in interstitial water at levels 2-6 feet below the sediment-water interface. This information may be useful in predicting value of dredging for lake restoration. Freezing and storage changes sediments; only fresh sediments give accurate determinations of soluble nutrients in interstitial water. Irradiation of sediments with cobalt for sterilization increased soluble orthophosphate and soluble organic compounds in interstitial water. Laboratory experiments indicate Upper Klamath Lake, Oregon, sediments promote algal growth and elimination of sediment nutrient release by addielimination of seminent interfere rockes of about tives forming hydrous oxides and insoluble phosphates indicate that this technique may provide only temporary lake restoration. (See Vol 3, vide only temporary lake restoration. (See No 7, Field 5C, entry W70-02775). (Jones-Wisconsin) W70-03980

TRACE ELEMENT MEASUREMENTS IN THE AQUATIC ENVIRONMENT, Washington State Univ., Pullman. Dept. of Sanitary

Engineering. William H. Funk, Surinder K. Bhagat, and Royston

Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, Califorhis Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 207-221. 6 fig, 3 tab, 30 ref.

Descriptors: *Trace elements, *Aquatic environment, Carbon radioisotopes, Algae, Neutron activation analysis, Gamma rays, Cyanophyta, Iron, Cobalt radioisotopes, Sodium, Irradiation, Manganese, Copper, Potassium radioisotopes, Zinc radioisotopes, Strontium radioisotopes, Uranium radioisotopes, Hypolimpion, Enjimpion, There radioisotopes, Hypolimnion, Epilimnion, Thermocline, Diatoms, Radioisotopes, Scenedesmus. Identifiers: Particulate matter, Micronutrients, Sodium iodide, Germanium, Washington, Columbia plateau, Aphanizomenon flos-aquae, Chromium radioisotopes, Scandium radioisotopes, Antimony radioisotopes, Rubidium radioisotopes, Thorium radioisotopes, Mercury radioisotopes, Barium radioisotopes, Bromium radioisotopes, Gallium radioisotopes, Lanthanum radioisotopes, Cladophora, Spirogyra, Fragilaria, Stephanodiscus.

Activation analysis appears suitable for direct study of the aquatic environment. Procedures developed could be initially utilized to survey lakes and streams to delimit the micronutrients available, simplifying tests for algal responses to additions of specific micronutrients (since it would be known which were abundant and which deficient); responses could then be measured by carbon-14 or other suitable methods. Speculation is impossible on nutritional requirements or trace element composition of algae tested because of the limited number of analyses made and difficulty in eliminating particulate matter adhering to algal cells. enough data are gathered and procedures stan-dardized, it may be possible to determine algal growth patterns that are directly related to either overabundance or lack of certain trace elements. It is possible that algae exerts a far greater influence on nutrition of a lake or stream than heretofore believed; they may act as flocculating agents in set-tling nutrients from the water and alternately take up and release metals, or act as chelating agents complexing many metals and keeping them in solution. (See Vol 3, No 7, Field 5C, entry W70-02775). (Jones-Wisconsin) W70-03981

THE CLASSIFICATION OF LAKES,

Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.

John R. Donaldson.

Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 171-185. 7 fig, 2 tab, 7 ref.

Descriptors: *Lakes, *Classification, Biota, Ecosystems, Oregon, Oligotrophy, Alkalinity, Dis-solved solids, Hardness (Water), Temperature, Dissolved oxygen, Primary production, Depth, Phytoplankton, Growth rates, Fish, Foods, Zooplankton, Trophic level, Sockeye salmon, Nutrients, Physicochemical properties. Identifiers: *Oregon lakes, Woahink Lake (Ore), Waldo Lake (Ore), Odell Lake (Ore), Crater Lake

(Ore), Morphometry.

Grouping lakes on a regional basis is logical and the trophic nomenclature from oligotrophy to eutrophy is useful only in its broadest sense. Information was collected for Oregon lakes concerning abiotic and biotic conditions and punched onto cards. Density of a food resource is the result of the total output through production and the outflow through consumption and decomposition; thus, it becomes a real measure of changes in these rates or of environmental effects upon them. Production being the product of growth rate and biomass, a relationship is established between biomass and production. By defining relationships between nutrients and primary producers, production models can be developed allowing prediction of the effect of nutrient changes on consumer biomass. This relationship definition is advantageous in understanding the trophic process and providing useful information for the actual management of aquatic resources. Knowledge of density-dependent relations existing within a single lake, as well as among lakes, could significantly aid in establishing a meaningful lake classification scheme. Of greater import is the potential to plot trophic evolution of a lake through the biota instead of merely physically and chemically. (See Vol 3, No 7, Field 5C, entry W70-02775). (Jones-Wisconsin) W70-03984

FACTORS INFLUENCING ALGAL PRODUCTIVITY IN DEER CREEK RESERVOIR, UTAH, Utah Univ., Salt Lake City. Dept. of Zoology; and Iowa State Univ., Ames. Dept. of Sanitary En-

gineering.
Arden R. Gaufin, and Donald B. McDonald. Transactions American Microscopical Society, Vol 84, p 269-279, 1965. 1 fig, 1 tab, 7 ref.

Descriptors: *Algae, *Primary productivity, *Utah, *Reservoirs, Limnology, Sampling, Plankton, Stratification, Silica, Diatoms, Chlorophyta, Temperature, Surface waters, Distribution, Bays, Ecology, Light intensity, Currents (Water), Geolo-

Group 2H—Lakes

gy, Geographical regions, Shore-line cover, Car-bonates, Dissolved oxygen, Hydrogen ion concen-tration, Carbon dioxide, Bicarbonates, Nitrates, Phosphates, Ammonia, Physicochemical proper-Sewage, Hypolimnion, Thermocline, Solar radiation, Aquatic plants, Periphyton, Photosynthesis, Cyanophyta, Nitrites, Zooplankton, Nutrients, Cycling nutrients, Chrysophyta. Identifiers: *Deer Creek Reservoir (Utah), Provo River (Utah), Fragilaria capucina, Asterionella formosa, Stephanodiscus, Cyclotella, Wasatch County (Utah), Flagellates, Seasonal effects, Depth distribution.

Limnological studies (1957-1959) of Deer Creek Reservoir revealed well-defined chemical and thermal stratification during summer, terminating with autumnal overturn. Inflowing waters of the Provo River and seasonal changes were, seemingly, primary influences on chemical conditions; plankton pulses exerted a lesser effect, although silica concentrations were reduced during diatom blooms. Plankton distribution varied seasonally, and although species composition varied during the three years, a general pattern was evident within the reservoir. In winter, Fragilaria capucina, Asterionella formosa, Stephanodiscus, and, in 1959, Cyclotella predominated below the ice. In spring, diverse species of chlorophytes (green algae) appeared in response to recirculating and incoming nutrients. In surface samples, numbers of Asterionella, Stephanodiscus and other diatoms decreased as temperatures increased, and various chlorophytes became common. With autumnal overturn, Asterionella and Stephanodiscus reap-peared at surface. Species of chlorophytes varied widely during three years, while predominant diatoms remained constant in 1957-1958. Many plankters were apparently relatively restricted to certain strata of water, but were often displaced by vertical currents. Horizontal distribution was irregular. Generally, open water of the reservoir supports a homogeneous algal flora somewhat different from those in shallow bays. (Jones-Wisconwin) W70-03986

FLORIDA'S LAKES (PROBLEMS IN A WATER PARADISE).

For primary bibliographic entry see Field 06E.

2I. Water in Plants

YIELD-PROTEIN RELATIONSHIPS IN WHEAT GRAIN, AS AFFECTED BY NITROGEN AND WATER,

Nebraska Univ., Lincoln. For primary bibliographic entry see Field 02G. W70-03800

FUNCTIONS FOR COTTON (GOSSYPIUM HIR-SUTUM L.) PRODUCTION FROM IRRIGATION AND NITROGEN FERTILIZATION VARIABLES: II. YIELD COMPONENTS AND QUALITY CHARACTERISTICS, California Univ., Davis. Dept. of Water Science and Engineering; and California Univ., Davis. Dept. of Agronomy. Donald W. Grimes, W. L. Dickens, and W. D. Anderson.

Anderson.

Agronomy Journal, Vol 61, No 5, p 773-776, Sept-Oct 1969. 3 tab, 3 fig, 16 ref.

Descriptors: *Crop response, *Cotton, *Irrigation efficiency, *Plant growth, *Nitrogen, Arid lands, California, Soil-water-plant relationships, Statistics, Crop production, Fibers (Plant). Identifiers: *Production function, Plant quality.

Tests were conducted on 2 soils in the arid San Joaquin Valley of California to develop relationships of applied irrigation water and nitrogen to cotton yield components, plant height and fiber quality. Equations were developed relating plant height, flowers, bolls and lint quality to the amount of water applied for 3 levels of nitrogen. There was a positive correlation between yield and number of flowers and bolls. Plant height continued to increase with additional water, but beyond a certain point lint yield responded negatively. Fiber quality was primarily a function of water rather than nitrogen. (Crouse-Arizona) W70-03805

FUNCTIONS FOR COTTON (GOSSYPIUM HIR-SUTUM L.) PRODUCTION FROM IRRIGATION AND NITROGEN FERTILIZATION VARIA-BLES: I. YIELD AND EVAPOTRANSPIRATION, California Univ., Davis. Dept. of Water Science and Engineering.

Donald W. Grimes, H. Yamada, and W. L. Dickens

Agronomy Journal, Vol 61, No 5, p 769-773, Sept-Oct 1969. 2 tab, 6 fig, 13 ref.

Descriptors: *Arid lands, *Irrigation efficiency, *Cotton, *Plant growth, *Evapotranspiration, Clays, Loam, California, Economic efficiency, Nitrogen, Water utilization, Crop production, Crop

Identifiers: *Production function.

Water use efficiency for cotton (kg. of lint produced per cm. of water used in the evapotranspiration process) was studied on 2 soil types in the arid San Joaquin Valley of California. One type was clay loam and the other a fine sandy loam. Two inputs, irrigation water and nitrogen, were varied. Relative yield was expressed as a function of evapotranspiration with a regression equation. Increasing increments of water resulted in curvilinear vield responses on both soils for all levels of nitrogen. In both cases a maximum yield level was reached and beyond that additional water application resulted in reduced efficiency. Response to nitrogen was more marked on the sandy loam than the clay loam. Production functions are useful for technical crop management and for determining economic efficiency of inputs. (Crouse-Arizona)

ROOTZONE SALT PROFILES AND ALFALFA GROWTH AS INFLUENCED BY IRRIGATION WATER SALINITY AND LEACHING FRAC-

Agricultural Research Service, Riverside, Calif. Soil and Water Conservation Research Div.; and Agricultural Research Service, Riverside, Calif. Salinity Lab.
For primary bibliographic entry see Field 02G.
W70-03807

INFILTRATION RATES AS AFFECTED BY DESERT VEGETATION,

Arizona Univ., Tucson. For primary bibliographic entry see Field 02G. W70-03864

2J. Erosion and Sedimentation

GAMMA-RAY SPECTROSCOPY AS A TOOL FOR A RAPID INVESTIGATION OF DETRITIC

CORES, Centre National de la Recherche Scientifique, Gif-sur-Yvette (France). Centre des Faibles Radioactivities.

For primary bibliographic entry see Field 07B. W70-03650

EOLIAN MICRORIDGES ON BEACHES AND A POSSIBLE ANCIENT EXAM-

Geological Survey, Menlo Park, Calif. For primary bibliographic entry see Field 02L. W70-03661

MOBILE-BED FLUVIOLOGY.

Alberta Univ., Edmonton. Dept. of Civil Engineer-

Edmonton, Canada, The University of Alberta Press, 1969. 168 p, 30 fig, 24 plate, 178 ref, 2 ap-

Descriptors: *Open channel flow, *Bed load, *Sedimentation, *Erosion, *Regime, River flow, Silting, Sediment control, Streamflow, Sediment load, Civil engineering, Channel morphology, Hydraulic engineering, Hydraulic design, Hydraulic models, Hydraulic structures, Degradation (Stream)

Identifiers: * Mobile-bed hydraulics, Textbooks.

Mobile-bed hydraulics is discussed in a textbook intended for use in graduate courses and by professional civil engineers, hydraulic engineers, hydrologists, and water managers. Sediment transport, erosion, and sedimentation are examined from the viewpoint of self-adjustment after a disturbance of equilibrium. The first 5 chapters teach basic principles, illustrated by field cases, and warn against dangers in interference with field regime. Two chapters lay the theoretical base for analysis of regime and for hydraulic design. The remaining chapters develop approximate practical applica-tions of the basic equations. The design and research uses of hydraulic and mathematical models are given. (Knapp-USGS) W70-03669

THE INFRA-RED DETERMINATION OF QUARTZ IN SEDIMENTS AND SEDIMENTARY

Liverpool Univ. (England). Dept. of Oceanog-

raphy. For primary bibliographic entry see Field 07B. W70-03678

DEVELOPMENT OF A RADIOISOTOPE GAGE FOR MONITORING SEDIMENT CONCENTRA-TION IN RIVERS AND STREAMS, Panametrics, Inc., Waltham, Mass.

For primary bibliographic entry see Field 07B.

SOME PROPOSALS OF THE STOCHASTIC METHOD OF FORECASTING FOR DEPOSITS IN RESERVOIRS,

Osaka Univ. (Japan). Dept. of Civil Engineering. Akira Murota.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 49, p 376-383, 1967. 8 p, 4 fig, 2 tab.

Descriptors: *Reservoir silting, *Statistical methods, *Sedimentation, Landslides, Stochastic processes, Sediment transport, Probability, Mass wasting, Markov processes, Queueing theory, Rain-

fall, Forecasting.
Identifiers: Landslide probability, Landslide forecasting.

Usually forecasts of reservoir sedimentation have been made conventionally by using some empirical values of expected annual deposits. Because the debris yield is directly transported into the reservoirs at the upper reach of a river, the inflow rate of debris into the reservoirs would be highly related to the occurrence of mass movement. Heavy rains may be the prime trigger of mass movements, and the occurrence of mass movement. Heavy rains may be the prime trigger of mass movements, and may be treated by probability methods. After establishing probability distribution of the debris inflow, every state of the deposition processes, which would be considered as stochastic sequences, may be numerically calculated by means of the queueing theory under the assumption that each stage is a Markoff process. Numerical calculations are given for the Koyadaira basin at the Kurobe reservoir in northern Japan. (Knapp-USGS)

Chemical Processes—Group 2K

SEDIMENT YIELDS FROM THE CENTRAL COLORADO SNOW ZONE, Forest Service (USDA) Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station. Charles F. Leaf.

Journal of the Hydraulics Division, Proceedings of ASCE, Vol 96, No HY1, p 87-93, Jan 1970. Proc Paper 7006.

Descriptors: *Sediment yield, *Watershed management, *Water-yield improvement, Erosion, Eronsion control, Sediment discharge, Sediment rates, Sedimentation, Sediments, Trap efficiency, Cutting management, Colorado. Identifiers: *Experimental watersheds.

To determine the effects of roads and forest-cover To determine the effects of roads and forest-cover changes on sediment yields, measurements were made on one carefully logged and two undisturbed watersheds in the Fraser Experimental Forest, Colorado. Annual sediment yield averaged 200 pounds per acre immediately following road construction in 1950-52 and logging in 1954-56. In the period 1958-66 sediment yield averaged 43 pounds per acre, despite an estimated 25 percent increase in annual runoff caused by the harvest, compared in annual runoff caused by the harvest, compared with yields of 11 and 21 pounds per acre on the undisturbed watersheds. W70-03821

EROSION OF CIRQUES,

North Carolina Univ., Chapel Hill. Dept. of Geolo-

gy. William A. White. Journal of Geology, Vol 78, No 1, p 123-126, Jan 1970. 4 p, 2 fig, 1 plate, 10 ref.

Descriptors: *Erosion, *Cirques, *Glaciers, Topography, Geomorphology, Ice, Scour.
Identifiers: Cirque erosion, Alpine glaciers, Degradation (Glacial).

It is suggested that cirques are formed by deepening through glacial erosion on their floors rather than by headward sapping on their walls. This idea is supported by: (1) dovetailing or interfingering of cirques on opposite sides of narrow aretes; (2) crater cirques that occupy the entire top of in-dividual mountains; and (3) the rarity of cols and greater rarity of passes in narrow aretes. (Knapp-USGS) W70-03846

CONSTRAINED RANDOM WALK MEANDER GENERATION,

IBM Watson Research Center, Yorktown Heights,

For primary bibliographic entry see Field 02E. W 70-03866

AN ERROR FUNCTION DESCRIPTION OF THE VERTICAL SUSPENDED SEDIMENT DIS-VERTICAL SUSPENDED SEDIMENT DISTRIBUTION,
Agricultural Research Service, Oxford, Miss. Sedi-

mentation Lab.

Joe C. Willis. Water Resources Research, Vol 5, No 6, p 1322-1329, Dec 1969. 8 p, 6 fig, 1 tab, 3 ref.

Descriptors: *Suspended load, *Mathematical models, *Sediment distribution, Laboratory tests, On-site tests, Diffusion, Dispersion, Model studies, Sediment transport.

Identifiers: Error function distributions.

A new model for the vertical distribution of suspended sediment, which has the form of an error or Gaussian distribution function, agrees with the classical model in the central flow region and has a major advantage in that its integral over the flow depth converges to a consistent estimate of the measured average sediment concentration. The measured average sections predicted by the model compare favorably with concentrations derived from sediment load measurements in both the laboratory and the field. The theoretical diffusion coefficient distributions associated with classical

and error function models are also similar. (Knapp-USGS) W70-03873

UNIFICATION OF DATA ON SEDIMENT TRANSPORT IN FLUMES BY SIMILITUDE PRINCIPLES.

Agricultural Research Service, Oxford, Miss. Sedimentation Lab.

Joe C. Willis, and Neil L. Coleman.

Water Resources Research, Vol 5, No 6, p 1330-1336, Dec 1969. 7 p, 5 fig, 2 tab, 17 ref.

Descriptors: *Sediment transport, *Hydraulic models, *Hydraulic similitude, Simulation analysis, Model studies, Laboratory tests, Mathematical models, Mathematical studies, Open channel flow, Suspended load, Bed load. Identifiers: Similitude analysis.

Similitude criteria for flow with sediment transport are derived by normalizing equations of continuity and motion for flow in an alluvial channel. The well-known Reynolds and Froude numbers are obtained as well as a transport similitude number that prescribes the sediment effects on the inertial, gravitational, and viscous forces acting in the flow system. The Froude number along with a similitude number for the median diameter of the sediment particles is found to specify transport similitude for various flume investigations. A unified correlation of sediment discharge data from numerous labora-tory flume studies is developed through the similitude analysis. (Knapp-USGS)

2K. Chemical Processes

'SALT-BISCUITS' - A SPECIAL GROWTH STRUCTURE OF NaCI IN SALT SEDIMENTS OF THE TUZ GOLU ('SALT LAKE'), TURKEY, Heidelberg Univ. (West Germany). Sediment Research Lab. German Muller, and Georg Irion.

Journal of Sedimentary Petrology, Vol 39, No 4, p 1604-1607, Dec 1969. 4 p, 5 fig, 4 ref.

Descriptors: *Chemical precipitation, *Sodium chloride, *Salts, *Lakes, *Water chemistry, Sediments, Evaporation, Surface waters, Sedimentation, Particle shape. Identifiers: *Turkey, Tuz Golu (Salt Lake).

Biscuit-shaped NaCl disks are the main constituents of a special sediment type in evaporating Tuz Golu, Turkey. Their origin can be observed directly: thin salt flakes grow in the surface water layer of the basin and settle down. After deposition they continue growing in all directions, larger NaCl crystals developing at the bottom, smaller ones on the top of the disks. (Gabriel-USGS) W70-03671

STABILITY OF CALCIUM CARBONATE POLYMORPHS IN WARM, SHALLOW SEA-WATER.

Brown Univ., Providence, R.I.

H. Dale Winland.

Journal of Sedimentary Petrology, Vol 39, No 4, p
1579-1587, Dec 1969. 9 p, 3 fig, 2 tab, 16 ref.

Descriptors: *Calcium carbonate, *Sea water, *Shallow water, Magnesium, Calcite, Ions, Chemical analysis, Water chemistry, Magnesium carbonates, Sediments, Limestones, Recent epoch, Xray analysis, Stability, Energy, Trace elements. Identifiers: British Honduras Shelf, Bahama Bank, Calcium carbonate stability.

Skeletal elements originally high Mg calcite are recrystallized to aragonite in Recent marine carbonate sediments. An explanation is proposed based on the stability of the calcium carbonate polymorphs. The stability fields defined for calcite and aragonite from experimentation with pure

minerals in distilled water should not be projected unmodified into the marine environment because ions other than calcium can substitute for calcium in their crystal structures. A condition of equilibrium between coexisting crystalline calcium carbonate and seawater can be reached only if the distribution of major and minor ions between the separate phases is in equilibrium. Aragonite in equilibrium with seawater should contain about 0.9 mol % Sr and have a free energy of formation of about -269.5 kcal/mol. Calcite in equilibrium with seawater should contain about 10 mol % Mg and have a free energy of formation of about -267.0 kcal/mol; therefore low Mg calcite is not in equilibrium with seawater in shallow marine environments. Of the impure polymorphs, aragonite has the lower free energy of formation and should be the thermodynamically stable form in shallow marine environments. Partition and stability information show that marine carbonate sediments cannot undergo diagenesis to normal limestones, containing 1 to 3 mol % Mg, in marine water. (Garbiel-USGS) W70-03672

HURRICANE TRITIUM I: PRELIMINARY RESULTS ON HILDA 1964 AND BETSY 1965, Miami Univ., Fla. Inst. of Marine Science. For primary bibliographic entry see Field 02B. W70-03693

APPLICATION OF DEUTERIUM ANALYSES
TO THE HYDROLOGY OF THE LAKES OF
THE GRAND COULEE, WASHINGTON,
Geological Survey, Denver, Colo.; and Woods Hole
Oceanographic Institution, Mass.

Irving Friedman, and Alfred C. Redfield

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 77-80, 1967. 4 p, 1 fig.

Descriptors: *Deuterium, *Lakes, *Heavy water, Descriptors: *Deuterium, *Lakes, *Heavy water, *Tracers, *Radioactivity techniques, Washington, Evaporation, Freezing, Water sources, Water chemistry, Surface waters, Canal seepage, Water balance, Reservoirs, Inflow, Streams, Groundwater, Hydrogeology. Identifiers: *Grand Coulee (Wash).

The heavy isotopic forms of water, HDO and water containing O-18 occur in natural waters and can serve as natural tracers. Changes in deuterium content take place by freezing or evaporation. The probable sources of water pumped from the ground can be identified by measuring deuterium and ionic composition. Change in concentration of deuteri-um by evaporation follows different laws than does the change in ionic content. The hydrology of a series of lakes that occupy the abandoned gorge of the Columbia River was studied by isotopic analysis. Deuterium analysis shows that the upper lakes, Park and Blue, receive over 90% of their water from upstream surface inflow. Soap Lake is fed mainly by irrigation canal leakage, and a little seepage from another lake. Simultaneous equations for the balance of water, deuterium and salt were used to estimate the character and quantity of inflow and outflow from natural water reservoirs. (Carstea-USGS) W70-03696

STREAM WATER SAMPLER,
Forest Service (USDA), Corvallis, Oreg. Pacific Northwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 07B.
W70-03856

THERMO-OSMOSIS THROUGH COMPACTED

SATURATED CLAY MEMBRANES, Gulf Research and Development Co., Pittsburgh,

For primary bibliographic entry see Field 02G. W70-03859

Group 2K—Chemical Processes

REGIONAL VARIATIONS OF RIVER WATER REGIONAL VARIATIONS OF RIVER WATER COMPOSITION RESULTING FROM HALITE SOLUTION, MACKENZIE RIVER DRAINAGE BASIN, CANADA, Research Council of Alberta, Edmonton; Calgary

Research Content of Alberta, Editionion, Capary Univ. (Alberta); and Dept. of Energy, Mines and Resources, Calgary (Alberta). Inland Waters Br. Brian Hitchon, A. A. Levinson, and S. W. Reeder. Water Resources Research, Vol 5, No 6, p 1395-1403, Dec 1969. 9 p, 3 fig, 1 tab, 28 ref.

Descriptors: *Water quality, *Water chemistry, *Leaching, *Saline water, Saline water systems, Chlorides, Brines, Groundwater movement, Runoff, Infiltration, Overland flow. Identifiers: Halite, Mackenzie River (Canada).

The composition of surface waters in the Mackenzie River drainage basin falls into three general groups: (1) rivers entering the Slave-Mackenzie system from the west which have total dissolved solids of 100-200 mg/l and chloride in the range less than 1 mg/l in their headwaters to 2-5 mg/l at their mouths; (2) surface waters on the Canadian Shield which have lower total dissolved solids (less than 100 mg/l) and chloride (less than 1 mg/l); and (3) the Slave and Mackenzie rivers and the Great Bear and Great Slave lakes, which have total dissolved solids 100-200 mg/l and chloride 5-10 mg/l. Cross sections with evidence of solution collapse structures and anomalous depositional thicknesses indicate extensive solution of Middle Devonian halite and movement of the resulting brines to discharge areas near the Slave River. Chemical and isotopic analysis of saline springs in the discharge area show an origin by solution of halite (and gypsum) by meteoric water. (Knapp-USGS) W 70-03860

DIEL AND SEASONAL VARIATIONS IN PHYSIOCHEMICAL LIMNOLOGY, SPEED

RIVER, ONTARIO, Guelph Univ. (Ontario).

John R. M. Kelso, and Hugh R. MacCrimmon. Water Resources Research, Vol 5, No 6, p 1388-1394, Dec 1969. 7 p, 4 fig, 1 tab, 11 ref.

Descriptors: *Water chemistry, *Water quality, *Diurnal, *Biochemistry, Limnology, Rivers, Trace elements, Ammonia, Chlorides, Nitrates, Silica, Phosphates, Sulfates, Hydrogen ion concentration, Dissolved oxygen. Identifiers: *Canada, *Speed River (Ontario).

Diel pulses occurred in pH, dissolved oxygen, and

free carbon dioxide in Speed River, Ontario. Iron and fluoride levels were stable. Total alkalinity, siland fuoride levels were statile. Total arkaning, sin-ica, and turbidity levels varied, but not signifi-cantly. Wide diel ranges existed in ammonia, chloride, nitrate, nitrite, orthophosphate, sulfate, and specific conductance levels. High hexavalent chromium levels (0.57 mg/l) occurred only on one occasion. Diel means of these characteristics showed seasonal change fitting the seasonal trends evident during the year of observation. The nature and extent of diel variation are generally required to determine an effective procedure for examination of local changes in limnologic conditions. (K-napp-USGS)
W70-03861

A WORKING MODEL FOR THE VARIATION IN STREAM WATER CHEMISTRY AT THE HUBBARD BROOK EXPERIMENTAL FOREST,

HUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE, Dartmouth Coll., Hanover, N.H.; Yale Univ., New Haven, Conn.; Geological Survey, Washington, D.C.; and Forest Service (USDA), Durham, N.H. Noye M. Johnson, Gene E. Likens, F. H. Bormann, D. W. Fisher, and R. S. Pierce.
Water Resources Research, Vol 5, No 6, p 1353-1363, Dec 1969. 11 p, 4 fig, 5 tab, 17 ref. NSF Grants GB1144, GB4169, GB6757, and GB6742.

Descriptors: *Water chemistry, *Water quality, *Small watersheds, *Surface-groundwater relationships, *Rainfall-runoff relationships, New Hampshire, Demonstration watersheds, Leaching, Mixing, Solutes, Aqueous solutions, Infiltration, Base flow, Seepage, Streamflow, Bank storage. Identifiers: Hubbard Brook Experimental Identifiers: Watershed (NH)

Stream water chemistry varies hyperbolically with stream discharge through four decades of discharge change within the Hubbard Brook Experimental Forest. New Hampshire. This dilution process is most simply explained by the mixing of rain water or surface water with deeper soil water. The resultant mixture of waters subsequently appears as stream water. Sodium and silica concentrations in stream water are markedly diluted during high discharge periods while hydrogen ion, aluminum, and nitrate concentrations are increased. Magnesium, calcium, sulfate, chloride and potassium concentrations are changed very little by stream discharge variations. During the summer, biologic activity measurably reduces the concentration of nitrate and potassium in stream water. (Knapp-HSGS) W70-03867

IRON IN NATURAL WATERS--ITS CHARACTERISTICS AND BIOLOGICAL AVAILABILITY AS DETERMINED WITH THE FERRI-GRAM.

Univ., Minneapolis. Limnological Research Center.

Joseph Shapiro.

Verhandlungen der Internationalen Vereinigung fur theoretische und angewandte Limnologie, Vol 17, p 456-466, 1969. 15 fig, 1 tab, 5 ref.

Descriptors: *Bioassay, *Iron, Hydrogen ion concentration, Inorganic compounds. Identifiers: *Ferrigram (Histo (Histogram), EDTA,

Ethylenediaminetetraacetate, Fingerprint technique, Ferric iron, Potassium thiacynate, Opti-

Ferric iron of surface waters was permitted to react with potassium thiocyanate (KSCN) at pH values ranging from 4.0 to 0.5. The results were expressed in the form of a histogram, called ferrigram. Depending on the nature of water, increase in reacta-bility of iron with KSCN was either at higher or lower pH values thus rendering 'right-handed' and 'left-handed' ferrigrams. A mixture of two waters produced racemic results approaching arithmetic average. Addition of ethylenediaminetetraacetate (EDTA) increased the reactivity of iron in more acid solutions. Bioassay employing Microcystis aeruginosa and Gloeotrichia echinata indicated that availability of iron is related to the shape of the ferrigram. The ferrigram is a useful tool for empirical fingerprinting of iron in natural waters. (Wilde-Wisconsin) W70-03954

PRINCIPLES OF PRIMARY PRODUCTIVITY: PHOTOSYNTHESIS UNDER COMPLETELY NATURAL CONDITIONS,

Bowling Green State Univ., Ohio. Dept. of Biology. Jacob Verduin.

Algae and Man (Jackson, D F, editor) Plenum Press, N Y, p 221-238, 1964. 3 fig, 3 tab, 6 ref.

Descriptors: *Primary productivity, *Photosynthesis, *Environmental effects, Respiration, Ponds, Phytoplankton, Limiting factors, Physiological ecology, Carbon dioxide, Phosphorus, Nitrogen, Iron, Nutrients, Aquatic habitats, Light, Hydrogen ion concentration, Pennsylvania, Euglena, Lakes, Lake Erie, Michigan, Analytical techniques, Oxygen

ygen. Identifiers: *Photobiology, *Chemical processes, Glenodinium, Trachelomonas, Predictive equations, Ceratium, Baule-Mitscherlich equation, Thiel College (Pa), Ulva lactuca, Algal popula-Suspensoid concentrations, Lambert-Beer law, Suspensoid concentrations, Winkler technique, Community metabolism, Young's Pond (Pa), Brown's Pond (Pa), West Lost Lake (Mich), Maumee River, Ohio River, Pymatuning Reservoir Individual determinations of primary productivity vary widely, both spatially and temporally. Simper methods for determining such rates, permitting acquisition of many data, are preferable to more precise, but time-consuming techniques. Studies under completely natural conditions are desirable because in bottled samples, surface effects yield erroneous values for both photosynthesis and respiration. Community metabolism can be assessed by measuring, over short intervals, changes in dissolved oxygen by Winkler's techniques, and changes in concentration of carbon dioxide by differential titration. Estimates of hourly photosynthetic rates per microliter of phytoplankton, determined thus for two small ponds, are in good agreement with data reported in the literature. Analysis of photosynthetic yields, based on theoretical considerations and on the Baule-Mitscherlich equation for limiting factors, suggests that, among physical, chemical, and biotic factors, several factors can simultaneously limit photosynthetic yield. Substantial reduction of optimal yield is probably the rule in aquatic environments. The Lambert-Beer's law, describing attenuation of light in water, can be modified by adding an exponential term for concentration of lightadsorbing particulates. Several applications of the resultant equation to aquatic environments are recommended for further study. (See Vol 2, No 19, Field 5C, entry W69-07832). (Eichhorn-Wisconsin) W70-03965

2L. Estuaries

EOLIAN MICRORIDGES ON MODERN BEACHES AND A POSSIBLE ANCIENT EXAM-PLE.

Geological Survey, Menlo Park, Calif.

Ralph E. Hunter.

Journal of Sedimentary Petrology, Vol 39, No 4, p 1573-1578, Dec 1969. 6 p, 5 fig, 17 ref.

Descriptors: *Sedimentary structures, *Beaches, *Sands, Winds, Wind velocity, Geology, Waves (Water), Ripple marks, Particle size, Sandstones, Identifiers: Eolian microridges.

Eolian microridges consist of a series of anastomosing ridges less than 1 cm in wave length. Eolian microridges have been observed to form where sand was being blown in saltation across wet sand surfaces, mostly on beaches. The ridges and intervening troughs are oriented transversely to wind direction and commonly have several types of asymmetry by which the direction of the wind that formed them can be determined. The structure may be distinguished from ordinary ripples of unusually small wave length by several criteria other than wave length. Eolian microridges are potentially preservable and structures found on several bedding planes of the Keefer Sandstone (Middle Silurian) near Lewistown, Pennsylvania, are possibly preserved examples. These structure are possibly preserved examples. These structures, together with other evidence, strongly suggest a beach environment for this sandstone. (Gabriel-W70-03661

STABILITY OF CALCIUM CARBONATE POLYMORPHS IN WARM, SHALLOW SEA-WATER,

Brown Univ., Providence, R.I. For primary bibliographic entry see Field 02K. W70-03672

THERMAL CIRCULATION ON A ROTATING SPHERE; WITH APPLICATION TO THE OCEANIC THERMOCLINE, Harvard Univ., Cambridge, Mass.; and Stockholm International Meteorological Inst. (Sweden).

A. R. Robinson, and Pierre Welander.

Journal of Marine Research, Vol 21, No 1, p 25-38, 1963. 2 fig. 4 ref. 1963. 2 fig, 4 ref.

Descriptors: *Model studies, *Mathematical model, *Stratification, *Thermocline, *Thermal stratification.

A mathematical model was developed of the thermal boundary layer beneath the surface of a differentially heated fluid portion of a rotating sphere, i.e., a region in which thermal conductivity is important but viscosity is negligible. A convective circulation in the rotating self-gravitating sphere is induced by prescribing a distribution of temperature on the free surface and a lower, constant temperature on the bottom. The motion is assumed to be laminar and steady. A general three dimensional similarity transformation is performed, and features of the related temperature and flow fields are studied. It was found that an upwelling of cold water into the boundary layer region from below is always necessary, that horizontal advection of heat is relatively negligible, and that a strong relation exists between boundary layer depth and surface forcing function. The solutions are examined for numbers characteristic of the main oceanic thermocline. (Guerrero-Vanderbilt)

NOTES ON THE THEORY OF THE THER-

New York Univ., Bronx. Dept. of Meteorology and Oceanography. Robert Blandford.

Journal of Marine Research, Vol 23, No 1, p 18-29, 1965. 4 ref, 4 fig.

Descriptors: *Thermocline, *Diffusion, *Heat balance, *Convection, Thermal stratification. Identifiers: Ekman layer,

An exact analytical solution is closed form for a steady, laminar model of the oceanic thermocline is presented. The model includes vertical diffusion and horizontal and vertical convection of heat. The solution satisfies boundary conditions that are in fair agreement with observation over the range of latitude of 10 deg to 45 deg. The behavior of the solution is given as a function of the imposed temperature and vertical velocity component at the bottom of the Ekman layer. A typical result of the analysis is that, as the surface temperature increases, the thermocline depth decreases, and the deep vertical velocity component increases. Subpolar gyres are shown to be excluded for some boundary conditions. The equations solved numerically by Stommel and Webster are shown to be exact and a derivation of Robinson's equations for an equatorial thermal regime is given. (Guerrero-W70-03726

ON THE ROLES OF VERTICAL VELOCITY

ON THE ROLES OF VERTICAL VELOCITY AND EDDY CONDUCTIVITY IN MAINTAINING A THERMOCLINE, Washington Univ., Seattle. Dept. of Oceanography. Roy Overstreet, and Maurice Rattray, Jr. Journal of Marine Research, Vol 27, No 2, p 172-190, 1969. 9 fig, 19 ref.

Descriptors: *Mathematical model, *Thermocline, *Heat balance, Thermal stratification.
Identifiers: *Eddy coefficient, *Mass transport.

A model was developed of the permanent thermocline from a simplified heat balance equation in which the horizontal advection and conduction of heat have been neglected. Steady state solutions describing the general features of the temperature distributions associated with both divergent and convergent Ekman layers have been obtained for various distributions of vertical velocity and eddy conductivity. Some conclusions were: (1) Given a conductivity. Some conclusions were: (1) Given a constant eddy coefficient, deep thermoclines can occur only in regions of Ekman convergence. (2) For divergent Ekman transport, a mixed layer can be modeled with an eddy coefficient that decreases with depth. (3) A variable eddy coefficient has an apparent advective effect. (4) Two of the solutions agree with observations in regions having respectively divergent and convergent Ekman mass transport. (Guerrero-Vanderbilt) W70-03730

ON THERMALLY MAINTAINED CIRCULA-TION IN A CLOSED OCEAN BASIN,

Harvard Univ., Cambridge, Mass. P. P. Niiler, A. R. Robinson, and S. L. Spiegel. Journal of Marine Research, Vol 23, No 3, p 222-230, 1965. 4 fig, 3 ref.

Descriptors: *Mathematical model, *Thermocline, *Circulation, Thermal stratification. Identifiers: *Thermohaline.

A three dimensional model was developed of a thermohaline-maintained circulation for a closed basin of finite depth on the beta plane. Diffusive processes were neglected and hence allow no interchange of momentum or heat with the region above the thermocline. The quasilinear, and quasigeostrophic, three dimensional problem was solved for the case of a semicircular basin of constant depth, where the potential vorticity is conserved in a relatively simple manner. The circulation, which conserves potential vorticity, consists of a wastward drift at all levels in the open ocean and a return flow that is accomplished in a swift eastward flowing current. A comparison was made to Worthington's paper on water mass analysis of deep circulation in the North Atlantic Basin. (Guerrero-Vanderbilt) W70-03732

SUBMERGENCE EFFECTS ON A RHODE ISLAND BARRIER AND LAGOON AND IN-FERENCES ON MIGRATION OF BARRIERS,

Rhode Island Univ., Kingston. Graduate School of Oceanography William P. Dillon.

Journal of Geology, Vol 78, No 1, p 94-106, Jan 1970. 13 p, 8 fig, 34 ref.

Descriptors: *Beaches, *Sedimentation, *Erosion, *Rhode Island, Waves (Water), Currents (Water), Provenance, Sediment transport, Sands, Beach erosion, Coasts, Deposition (Sediments), Geomorphology, Littoral drift, Surf, Silts, Tides, Vegetation effects. Identifiers: Cape Cod (Mass).

The Charlestown-Green Hill barrier beach-lagoon complex lies along Rhode Island's south shore. Barrier beach and tidal delta sands, lagoonal fine sediments, and lag deposits have been deposited on a base of glacial till, outwash, and glaciofluvial sand. The beach and lagoonal sediments have been derived mainly from reworking of glacial sediments. Tidal currents have built a sand delta at the inshore end of an inlet, but sand on the barrier beach's lagoonal side has been introduced over the barrier. Fine sediments are deposited in the deepter areas of the lagoon. The barrier beach was formed at a lower sea level, and moved landward as the sea transgressed, with lagoonal deposition migrating with the barrier. The small size of this barrier places its base at a shallow depth, resulting in erosion of the entire seaward side by storm waves and also permitting considerable transport of sand across the barrier to the lagoon side. The barrier has remained small because of lack of sand supply. Thus lack of sand supply seems to be the dominant factor in allowing the landward migration of this barrier. (Knapp-USGS) W70-03847

COMPUTER STUDIES OF FINITE-AMPLITUDE WATER WAVES, Stanford Univ., Calif. Dept. of Civil Engineering.

For primary bibliographic entry see Field 07C.

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

OPERATION OF SEA WATER DISTILLATION

PLANTS,
Office of Saline Water, Washington, D.C. Test and Evaluation Branch. Robert H. Evans

Journal of American Water Works Association, Vol 61, No 12, p 663-666, Dec 1969, 4 p, 4 fig.

Descriptors: *Desalination plants, *Efficiencies, *Water cost, Water supply, Water treatment, Distillation, Capital costs, Construction costs, Maintenance costs, Operating costs. Identifiers: *Desalination costs.

Operating expenses, water costs, plant availability, and life of desalination plants are briefly reviewed. Prior to 1962 the desalting industry built plants which operated at very low performance ratios (water produced/Btu input). Most plants operated at between 5 and 7 lb of water/1,000 Btu, below 185 deg F brine temperature, and generally used polyphosphates for scale control. These plants were generally small and produced relatively high cost water in areas with no alternative source of water. OSW distillation plants, as illustrated by Freeport and Pt. Loma, were operating at performance ratios of about 10 in 1963. With the new Clair Engle Plant design, the performance ratio was raised to 20 and in future hybrid plants it is expected to be of the order of 25. OSW increased operating temperatures to 250 deg F using acid for scale control. In the last 3 years processing capability has passed 250 mgd. The largest commercial installation in the United States, the Westinghouse 2.62-mgd multistage flash unit at Key West, Fla, cost \$4,056,000; it occupies 3.3 acres; and produces water at \$0.86/1,000 gal. It has been onstream over 90% and is extremely successful. (Knapp-USGS) W70-03657

DEVELOPMENT MATHEMATICAL MODEL AND COMPUTER PROGRAM FOR OP-TIMIZATION OF VERTICAL TUBE EVAPORA-TOR SALINE WATER PLANTS, Houston Research Inst., Inc., Tex.

A. E. Dukler, C. J. Huang, and M. L. Lee.

Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price \$2.25. Office of Saline Water Research and Development Progress Report No 404, Feb 1969. 164 p, 16 fig, 2 tab, 8 ref, 9 append. OSW Contract No 14-01-0001-657.

Descriptors: *Mathematical models, *Computer programs, *Desalination processes, *Desalination plants, Evaporators, Simulation analysis, Capital costs, Operating costs, Optimization, Dynamic programming, Systems analysis.
Identifiers: *Vertical tube evaporator desalting

plant, Multistage evaporator process simulation, Fortran

Techniques and mathematical models were developed for an optimum design of a VTE desalting plant. The optimization system is then programmed into an electronic computer which automatically searches and arrives at an optimum design. The computer program, as it results, is very flexible and versatile. The complete system is divided into 4 major subsystems which are Multistage Evaporator Process Simulation, Engineering Design Simulation, Capital and Operating Cost Calculation, and Optimum Searching Techniques. The Engineering Design Simulation and the Capital and Operating Cost Calculation are based on the design concept of a multistage evaporator system

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A—Saline Water Conversion

arranged into the concentric geometric configura-tion. Modification of these subsystems for other geometrical arrangements can be accomplished readily and with little difficulty. Instructions are given for preparing the input data cards as well as operating the system. The source program is written in Fortran IV. (Carstea-USGS) W70-03665

IMPROVED ANIONIC MEMBRANES FOR ELECTRODIALYSIS.

Monsanto Research Corp., Dayton, Ohio I. O. Salyer, E. V. Kirkland, and P. H. Wilken. Office of Saline Water Research and Development Progress Report No 483, Dec 1969. 43 p, 11 fig, 14 tab. OSW Contract No 14-01-0001-1769.

Descriptors: *Membranes, *Desalination process, Flon exchange, *Electrodialysis, Ammonium com-pounds, Hydrolysis, Saline water, Brackish water, Films, Research and development.

Identifiers: *Anionic membranes, Copolymenzation, Methyl iodide.

The preparation of aliphatic anion exchange membranes composed of ethylene-tri-methyl vinyl ammonium chloride copolymer involves four major steps: (1) copolymerization of ethylene and N-vinyl phthalimide, (2) film formation, (3) hydrolysis to ethylene-vinyl amine copolymer, and (4) quaternization with methyl iodide. It was found that distributed to the composition of the compositi butyl peroxide was an efficient initiator of the copolymerization reaction. The charge ratio was used to control the ratio of monomer in the copolymer products. The membranes were prepared by pressing the material between hot plates in a hydraulic press. Hydrolysis has been accomplished with hydrazine hydrate at temperatures below the reflux temperature. The experimental membranes have been compared with commercial membranes by means of several accepted screening tests. (Carstea-USGS) butyl peroxide was an efficient initiator of the

RESEARCH AND DEVELOPMENT ON LOW PRESSURE REVERSE OSMOSIS MEMBRANES AND DESIGN OF A SMALL UNIT FOR BRACKISH WATER,

Dartmouth Coll., Hanover, N.H.
Christian S. Miller, and D. Dean Spatz.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price \$0.60. Office of Saline Water Research and Development Progress Report No 339, Mar 1968. 55 p, 17 fig, 8 tab, 36 ref, 4 append. OSW Contract No 14-01-0001-939.

Descriptors: *Desalination processes, *Reverse os-*Water supply, Research and development, sh water, Membranes, Cellulose, mosis, *W Brackish Economics.

Identifiers: Cellulose acetate membranes, Polyester membranes, Drinking water.

Cellulose acetate desalination membrane technology and a simple, inexpensive desalination appliance which can supply water needs for a family of five are discussed. The proposed appliance will operate on the principle of reverse osmosis utilizing only the water pressure already present in the household water system. A testing program using a reverse os-mosis cell has established the economic feasibility of using the method in larger systems. (Carstea-USGS) W70-03667

THERMO-ECONOMICS OF SALINE WATER

CONVERSION, Dartmouth Coll., Hanover, N.H. Thayer School of

Robert B. Evans, and Myron Tribus.
I and EC Process Design and Development, Vol 4,
No 2, p 89-100, Apr 1965. 9 fig, 4 tab, 22 ref.

Descriptors: *Saline water, *Demineralization, *Thermodynamics, *Economics, Optimization, Energy, Desalination apparatus, Costs.

Identifiers: Optimum-energy technique.

The technological problems of saline water demineralization were set forth in concise form as they appeared in the light of an intensive study of the underlying principles of thermodynamics and economics. This was done by digesting the pertinent principles of thermodynamics and economics into a compact formalism which the writers call the 'Optimum-energy technique'. The essence of the optimum-energy technique was embodied in the use of the optimum-energy equation. The pertinent thermodynamics and economics were manifested in this equation in the form of two critical unit costs: energy costs and equipment costs. It was concluded that research programs in saline demineralization should be initiated for each type of desalination equipment with the specific goal of striving for lower conductance costs and lower available energy costs for each tentative energy source. Hope was expressed that optimumenergy technique, as a digest of the pertinent thermo-economics, would help to speed the advance of saline water conversion. (Thiuri-Cornell) W70-03935

DESIGN AND COST OF ION-EXCHANGE SOF-TENING FOR A 50-MGD SEA-WATER EVAPORATION PLANT, California Univ., Berkeley. Sea Water Conversion

Gerhard Klein, Kamel M. Makar, Badawi W.

Telemat, and Theodore Vermeulen.
Sea Water Conversion Lab Rep No 68-2, Water Resources Center Desalination Rep No 25, Sept 1968. 59 p, 12 fig, 10 tab, 31 ref, 2 append.

Descriptors: *Design, *Costs, *Ion-exchange, *Water softening, Optimization, Sea water, Distillation, Pre-treatment (Water), Economics, Interest rate, Evaporators. Identifiers: Calcium removal.

The optimization of a large desalting plant was discussed. Mathematical equations were developed and utilized to determine the economic feasibility of calcium removal by a large distillation plant. Sea water was pretreated to avoid scale formation during distillation. It was possible to express all costs that affected the optimization as functions of the that affected the optimization as functions of the saturation time elapsed in one cycle of operation. The design study resulted in an estimated cost for calcium removal of 3.6 or 3.8 cents per thousand gallons of distilled-water product from the evaporator, based on respective interest rates of 3.125 or 4.125 per cent per year on the depreciated plant investment. Since this pretreatment led to more economic distillation conditions, the attendant savings largely offset the cost of pretreatment. (Thiuri-Cornell) W70-03945

TECHNOLOGY OF SEA WATER DESALINA-

eir (G. and J.) Ltd., Glasgow (Scotland). Hugh C. Simpson, and R. S. Silver.
Selected Papers on Desalination and Ocean
Technology, Dover Publications, New York, p 387413, 1968. 3 fig, 2 tab, 7 ref.

Descriptors: *Desalination processes, *Fresh water, *Saline water, *Optimization, *Electrodialysis, *Reverse osmosis, Vapour compression distillation, Hydrate process, Mathematical studies. Identifiers: Transfer area.

The processes for the recovery of fresh water from sea water were analyzed and the minimum costs of sea water desalination corresponding to optimum driving forces across the transfer surface were estimated by use of mathematical methods. Under optimum conditions the cost of sea-water desalination decreased slowly as that a serious conditions the cost of sea-water desalination. decreased slowly as the cost of transfer area and power and the transfer resistance were reduced. Electrodialysis, reverse osmosis, and vapor recom-pression were all likely to produce more expensive fresh water than multi-stage distillation for any reasonable costs of the transfer surface. Freezing

and hydrate processes, on the other hand, could produce water at lower costs than could multi-stage distillation. However, the water costs for these latter two processes, have been under-estimated, since they can be evaluated with sufficient accuracy only by large scale experimental work. (Thiuri-Cornell) W70-03946

3B. Water Yield Improvement

SNOW ALBEDO MODIFICATION - A REVIEW

OF LITERATURE, Army Terrestrial Sciences Center, Hanover, N.H. For primary bibliographic entry see Field 02C. W70-03652

SHAPING THE LAW OF WEATHER CON-

For primary bibliographic entry see Field 06E. W70-03719

LABORATORY TESTS OF SPRAYABLE MATERIALS FOR RUNOFF INDUCEMENT ON

Hebrew Univ., Jerusalem (Israel). Faculty of Agriculture; and National Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture

For primary bibliographic entry see Field 02E. W70-03804

RUNOFF INDUCEMENT IN ARID LANDS,

National and Univ. Inst of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.

Daniel Hillel.

Final Technical Report to US Department of Agriculture, Rehovoth, 1967. 142 p, 34 tab, 46 fig, 83 ref. Project No A10-SWC-36. Grant No FG-Is-

Descriptors: *Arid lands, *Water harvesting, *Rainfall-runoff relationships, *Infiltration, *Soil *Kainfall-runoff relationships, *Infiltration, *Soil sealants, Surface runoff, Slopes, Rainwater, Small watersheds, Surface sealing, Soil compaction, Wettability, Soil dispersants, Rainfall, Simulated rainfall, Rainfall intensity, Water yield improvement, Soil erosion, Economic feasibility. Identifiers: *Israel.

If runoff from slopes can be artificially increased, it can be concentrated in crop planted areas. Thus, natural precipitation could be used more efficiently in agriculture. Results are presented of laboratory and field trials of several different materials and treatments tested to reduce infiltration and thereby increase runoff. All work was conducted in Israel. The various treatments were first screened in the laboratory with a specially designed rainfall simulator and the more promising were field tested in two areas. Results varied somewhat with soil type and rainfall intensity and duration. Under the right conditions it was found that runfff-to-rainfall ratios as high as 80 to 90% could be obtained. Types of treatments were mechanical smoothing and compaction and application of substances to bind, seal, crust, and waterproof the surface. The ultimate question is one of economic feasibility. Some preliminary cost figures are presented. (Crouse-Arizona) W70-03809

A METHOD FOR STATISTICAL EVALUATION OF WEATHER MODIFICATION AT THE RIVER FLOW CONTROL LEVEL,
Colorado State Univ., Fort Collins. Dept. of Civil

Engineering. Radmilo D. Markovic.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 80, p 641-647, 1967. 7 p, 3 fig, 2 ref. Bureau of Recla-mation Contract No 14-06-D-5229.

Conservation in Domestic and Municipal Use—Group 3D

Descriptors: *Weather modification, *Evaluation, *Streamflow, *Variability, *Statistical methods, Streamflow forecasting, Time series analysis. Identifiers: Weather modification evaluation.

The natural variability of river flows is relatively high and the expected increase in water yield caused by weather modification experiments is relatively low. These two conflicting facts call for a very refined and sensitive method of solving the problem of statistical evaluation of weather modification attainments. The method developed and presented is one answer to the problem of weather modification evaluation. It was employed at the river flow control level by using the annual river flows as the main variable. The target-control concept was used in the development of the joint distribution function of target river flows conditioned by those in the control basin and the upper tailed test of significance with the intention of maximizing the discriminating power of this statistical test. The applicability of this method is demonstrated by an actual example. (Knapp-USGS)
W70-03848

HYDROLOGIC EFFECTS OF RAINFALL AUG-

Stanford Univ., Calif. Dept. of Civil Engineering. For primary bibliographic entry see Field 02A. W70-03931

3C. Use of Water of Impaired Quality

DISTRIBUTION OF CHLORIDES IN AN IR-

DISTRIBUTION OF CHLORIDES IN AN IR-RIGATED CITRUS ORCHARD. National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research. B. Yaron, E. Mor, and A. Goell. Israel Journal of Agricultural Research, Vol 18, No 4, p 201-208, Oct 1968. 1 tab, 4 fig, 6 ref.

Descriptors: *Arid lands, *Irrigation water, *Saline water, *Chlorides, *Citrus fruits, Leaching, Soil chemistry, Irrigation, Water quality, Soil-water-plant relationships.
Identifiers: *Israel.

If relatively saline water is used in irrigation, a build-up of chlorides in the soil may be expected. A value of 10 to 15 meq per liter of saturated soil paste has been suggested as the level of toxicity for citrus. This paper reports the chloride level and movement in the soil for one season of irrigation with water containing 2.9, 8.5, 11.3 and 15.5 meq per liter chlorides. The chlorides tended to accumulate between 30-90 cm. depth. The mean chloride content did not reach the 15 meq per liter level in one season for any of the treatments. However, the chlorides were only partially leached by the following winter rains, so a continuous build-up of chlorides from year to year might be expected with continuous use of saline irrigation water. (Crouse-Arizona) W70-03799

3D. Conservation in Domestic and Municipal Use

PUBLIC PARKS, FORESTS AND RECREA-

Tenn Code Ann secs 11-1401 thru 11-1417 (Supp

Descriptors: *Tennessee, *Rivers, *Conservation, Water resources development, Legislation, Natural resources, Recreation, Eminent domain, Legal aspects, Administrative agencies, hederal govern-ment, Scenic easements, Local governments, River systems, Water pollution, Pollution abatement, Land use, Classification, Water conservation, Land management, Scenery.

River, free flowing, and scenic easements are defined. The three classes of scenic river areas are natural river areas, pastoral river and partially developed river areas. Natural river areas are those free-flowing rivers with shorelines and scenic vistas unchanged by man, with no extensive paralleling roads closer than one mile. Those free-flowing rivers, the lands adjacent to which are partially or predominately used for agriculture and other dispersed human activities which do not substantially interfere with public use and enjoyment of the rivers and their shores are pastoral river areas. Partially developed river areas are those rivers in areas affected by the works of man, but which still possess actual or potential scenic values. Regulations for the scenic rivers system which is administered by the Department of Conservation are provided. The Commissioner of Conservation establishes boundaries of the scenic river area and acquires land by donation, purchase, exchange, eminent domain or otherwise. Land uses permitted within a scenic river area are enumerated. The Commissioner of Conservation cooperates with appropriate water pollution control agencies and environmental management agencies for the purpose of eliminating or diminishing the pollution of waters within scenic river areas. (Powell-Florida) W70-03746

WETTING AGENT TESTS. Los Angeles City Fire Dept., Calif.

Los Angeles, Los Angeles City Fire Department, 1969. 16 p, 4 fig, 3 tab.

Descriptors: *Surfactants, *Wettability, *Surface tension, *Sprays, *Burning, Wetting.
Identifiers: *Wetting agents, *Firefighting, *Fire extinguishing, *Fire departments, Los Angeles City Fire Department.

A series of laboratory and field tests of wetting agents, conducted by the Los Angeles City Fire Department, is reported. The tests were made to evaluate the effectiveness, cost and practicality of using wetting agents as additives to water for facilitating fighting class A fires. The function of the wetting agents is to decrease the surface tension of the water droplets, and thereby increase water spread over combustible surfaces. It was found that the time and amount of water required to extinguish fires were considerably lessened when wetting agents were used. The increased penetration of water into burning materials, when wetting were used, reduced the potential of rekindles. In addition, firefighting efficiency was increased and the use of wetting agents proved to be economically feasible. No significant correlations were found to exist between field and laboratory tests. It was concluded that a method of metering the wetting agent directly into the firefighting apparatus, from a reservoir on the apparatus, should be developed. Recommendations were made for optimum wetting agent concentrations. Additional tests and development were recommended. (Poertner-Chicago) W70-03812

LIGHT WATER AND PROTEIN FOAM. Los Angeles City Fire Dept., Calif.

Los Angeles, Los Angeles City Fire Department, 1968. 31 p, 6 fig, 6 tab.

Descriptors: *Burning, *Wetting, *Sprays, *Sur-

Tactant, *Foaming, *Airports.
Identifiers: *Light water, *Protein foam, *Foaming agents, *Firefighting, *Fire extinguishing, *Extinguishing agents, Fire departments, Los Angeles City Fire Department, Airport fires.

The report is a detailed account of a series of tests and the Los Angeles City Fire Department to make comparative evaluations of firefighting characteristics of Light Water and Protein-Type foams. Light water is described as a non-toxic fluorescript materials with appropriate foams. fluorocarbon surfactant with appropriate foam sta-bilizers. The Protein foam liquid agent is non-cor-

rosive and contains stabilizers, metallic salts, and other materials and preservatives. Five sets of controlled tests were conducted in pits at the Los Angeles International Airport. The same firefighters were used for all tests and all firefighting was conducted under identical controlled conditions. Data were recorded on wind; temperature; humidity; amount and kind of fuel; temperatures of agent, water and fuel; fire intensity; time of preburn; time to control; time to extinguish; and amount of extinguishing agent used. The tests varied in size and intensity of fire, type of equipment used, and application rate of foaming agent. The Light Water foam proved superior to the Protein foam in every test. In one test, involving the use of two 300 gpm turrets on a 2,730 sq. ft. fire, the results indicated Light Water foam to be 3.64 times as effective as Protein foam. (Poertner-Chicago)

WATER CONSERVANCY DISTRICTS.

Mo Ann Stat secs 257.010 thru 257.150 (1959).

Descriptors: *Missouri, *Water districts, *Water conservation, *Water resources development, Water management (Applied), Water allocation (Policy), Administrative agencies, Legal aspects, Legislation, Water control, Flood control, Watersheds (Basins), Maintenance, River basins, Watershed management, River basin development Watershed management, River basin development, Multiple-purpose projects.

The purpose of a river basin conservancy district is to enable residents of the area to participate in maintaining and improving local water resources.
District projects may include alleviation of floods, conservation of water against drought, and development of the state's resources for sanitary, domestic, agricultural, recreational, and industrial purposes. 'River' and 'river basins' are defined. The purposes. 'River' and 'river basins' are defined. The circuit courts are authorized to organize river conservancy districts upon petition by affected landowners. A majority of those owning land within the proposed district must approve its creation in a referendum. (Powell-Florida)
W70-04029

WATER CONSERVANCY DISTRICTS. Mo Ann Stat secs 257.160 thru 257.310 (1959).

Descriptors: *Missouri, *Water conservation, *Water resources development, *Water districts, Water management (Applied), Water allocation (Policy), Administrative agencies, Construction, Maintenance, Legal aspects, Legislation, Water control, Water conveyance, Watercourses (Legal), Water distribution (Applied), Water works, Permits, Condemnation, Riparian rights, Easements, Right-of-way, Watersheds (Basins), River basins.

The board of trustees of a water conservancy district is authorized to clean out, straighten, widen, alter, deepen or change the course or terminus of any ditch, drain, sewer, river, watercourse, pond, lake, creek, or natural stream within the district. The board is empowered to fill up any abandoned or altered watercourse and to concentrate, divert, or divide the flow of water within the district. The board is permitted to purchase, acquire, hold, sell, convey, encumber, lease control, or use necessary land and personal property. The board may conrand and personal property. The board may construct, operate, maintain, preserve, or supervise engineering works and other works, improvements and facilities. The board of trustees may acquire any easement, riparian or other right within the district for right of way, holding basin or for any necessary purpose. Condemnation of land by the loand is negroited. The board of trustees are the board is permitted. The board of trustees makes regulations for the adjustment, connection or coordination of watercourses, works, facilities or operations of the district. The criteria and procedures for the creation of a conservancy district for a primary drainage basin are enumerated. (Powell-Florida) W70-04030

Field 03-WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3D—Conservation in Domestic and Municipal Use

PUBLIC UTILITIES.

Mo Ann Stat secs 71.520 thru 71.550 (1952).

Descriptors: *Missouri, *Public utilities, *Cities, *Municipal water, Legislation, Domestic water, Contracts, Supply contracts, Legal aspects, Regulation, Local governments, Electric power, Electricity, Water distribution (Applied), Fuels, Natural gas, Sewage disposal, Sewage, Conduits, Water works, Water supply, Pumping.

Municipalities may enact ordinances authorizing and regulating public utility companies supplying light, heat, power, water, gas, or sewage disposal facilities. A municipality may authorize these utilities to make excavations, set up fixtures, install mains, and maintain and operate their plants, sub-ject to the conditions of the ordinance, for a period of twenty years. Municipal authorities are authorized to contract with any Missouri corporaauthorized to contract with any Missouri corpora-tion for the purpose of supplying the municipality with gas, electricity, or water. It is provided, how-ever, that any such contract shall not have legal force until ratified by a two-thirds majority of those voting in a municipal election. Any municipality may contract, either separately or in conjunction with another municipality or private corporation, with any corporation engaged in pumping and delivering water at wholesale for domestic consumption. A municipality may own, either separately or in conjunction with another municipality or private corporation, water mains through which to procure an adequate supply of water for its inhabitants. Before any such contract shall be entered into, the contract must be approved by a majority of all the voters voting thereon at a special election held for that purpose (Schram-Florida) W70-04035

PUBLIC HEALTH (MUNICIPAL WATER SUPPLY)

Mo Ann Stat secs 71.700, 71.710 (1952).

Descriptors: *Missouri, *Cities, *Water supply, *Water sources, Legislation, Permits, Taxes, Wells, Water sources, Legislation, Permits, Taxes, Wells, Water wells, Spring waters, Regulation, Inspection, Control, Testing, Water pollution water pollution control, Public health, Water quality, Local governments, Water permits, Well permits. Identifiers: Licensing.

All cities in the state are authorized to regulate and license all springs, wells, or other sources of water supply from which water is sold or offered to the public or shipped for sale. The cities may levy and collect license taxes and provide for the inspection and analysis of such water supplies. All cities are authorized to enact ordinances for the protection of all water supply sources from contamination or danger of contamination. (Schram-Florida) W70-04036

MISSOURI SOIL AND WATER CONSERVA-TION DISTRICTS LAW.

Mo Ann Stat secs 278.060 thru 278.155 (1963), as amended, (Supp 1970).

Descriptors: *Missouri, *Soil conservation, *Water conservation, *Water districts, Administrative agencies, Administration, Financing, Legal aspects, Agencies, Administration, Financing, Legal aspects, Legislation, Adjudication procedures, Taxes, Eminent domain, Assessments, Cities, State governments, Federal government, Contracts, Equipment, Coordination, Agriculture, Conservation, Water policy, Water resources.

The State Soil and Water Districts Commission is created to administer the soil and water conservation districts. The Commission shall: (1) formulate general soil and water policies for the districts; (2) receive funds for, and control disbursements to, the districts; (3) provide for referendums for the establishment or disestablishment of districts; and (4) enter into agreements with, and cooperate with federal agencies. This act provides procedures for:

(1) the establishment of soil and water districts; (2) referendums; and (3) the establishment of boards of soil and water district supervisors. Soil and water districts shall: (1) be a corporate body; (2) promote measures for soil and water conservation; (3) cooperate with other agencies; (4) provide services, materials and equipment to land representatives; (5) accept contributions and expend monies; and (6) enter into contracts. Counties, cities and soil and water districts may cooperate for the purposes of this act. Soil and water supervisors may not levy taxes, issue bonds, make assessments, take contributions by exaction from soil and water districts, or exercise the right of eminent domain. (Marsee-Florida) W70-04041

3E. Conservation in Industry

MINERAL RIGHTS VERSUS WATER RIGHTS. For primary bibliographic entry see Field 06E.

3F. Conservation in Agriculture

EVAPORATIVE COOLING OF HEATED IR-RIGATION WATER BY SPRINKLER APPLICA-TION

Battelle Memorial Inst., Richland, Wash. Pacific

Northwest Labs. For primary bibliographic entry see Field 05D. W70-03718

DISTRIBUTION OF CHLORIDES IN AN IR-RIGATED CITRUS ORCHARD.

National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research. For primary bibliographic entry see Field 03C. W70-03799

AN EVALUATION OF THREE COEFFICIENTS AS A MEASURE OF UNIFORMITY OF WATER APPLICATION BY SPRINKLERS, Department of Agriculture, Swift Current (Saskatchewan). Research Station.

H. C. Korven.

Canadian Agricultural Engineering, Vol 10, No 2, p 83-84, Nov 1968. 1 tab, 7 ref.

Descriptors: *Sprinkler irrigation, *Application methods, *Uniformity coefficient, *Water measurement, Semiarid climates, Arid lands, Irrigation, Water management (Applied), Statistical methods, Measurement, Equations, Average, Spatial distribution, Regression analysis, Data processing, Rates of application.

Identifiers: *Canada, *Standard deviation,

Saskatchewan.

When designing and operating a sprinkler irrigation system, it is important to know the uniformity of water application, since a level of uniformity is more efficient in using water for crop production. Three coefficients of uniformity that have had wide attention were calculated and compared for 775 uniformity tests on the semiarid plains of Saskatchewan. They were Cu, U, and A. The larger the coefficient, the better the uniformity. A high degree of correlation was found among the three coefficients. The author concludes that any of the three coefficients is an acceptable measure, but he suggests U is most practical since it is based on standard deviation-one of the most efficient estimators--and is easier to calculate. (Crouse-Arizona) W70-03803

RUNOFF INDUCEMENT IN ARID LANDS. National and Univ. Inst of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research. For primary bibliographic entry see Field 03B. W70-03809

WATER FOR WESTERN FEDERAL IRRIGA-

TION PROJECTS, Washington State Univ., Pullman.

E. Roy Tinney.

Water Resources Management and Public Policy, Seattle, University of Washington Press, p 3-11, 1968. 9 p, 3 ref.

Descriptors: *Water supply, *Economic efficiency, *Irrigation, *Water resource development, Water losses, Water transfer, Demand, Cost, Government, Governments supports, Groundwater mining, Optimization, Value, Cost benefit analysis, Financing, Economic life, Income, Social aspects, Economic evaluation.

Identifiers: *Federal subsidies, *Social goals, Income distribution.

The chief agricultural problem of the West is the supply of irrigation water. Future federal irrigation developments should attempt to assure the nation of a fully adequate supply of the varieties of food and fiber, improve the general economy, and aid specific economicallydepressed areas. The federal government should adopt both an economic efficiency analysis and an income distribution analysis and abandon the hidden subsidies in benefit-cost analysis. Future federal projects should be ranked in ascending order of economic efficiency for each crop pattern so that Congress can make a more rational selection, taking note of the social goals involved. The article points out that interregional transfers should be analyzed on the basis of technological obsolescence of demand, crop production factors in the area of water abundance, the relative costs of water delivery at each end of the transfer, water losses incurred by the transfer and alternative means of increasing the water supplies in the recipient regions. (See W70-03995) (Murphy-Rutgers) W70-03996

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

FLOOD PLAIN INFORMATION, ROSILLO CREEK, BEXAR COUNTY, TEXAS.
Corps of Engineers, Fort Worth, Tex.

Prepared for San Antonio River Authority. Corps of Engineers Flood Plain Report, Jan 1970. 33 p, 5 fig, 12 plate, 11 tab.

Descriptors: *Floods, *Flood damage, *Texas, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood. Identifiers: *Bexar County (Tex), Standard project flood, Intermediate regional flood.

Flooding of Rosillo Creek, Bexar County, Texas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS) W70-03647

DETERMINATION OF OPTIMAL FLOOD PRO-TECTION LEVELS WITH SMALL EX-CEEDANCE PROBABILITIES, Carnegie-Mellon Univ., Pittsburgh, Pa.

For primary bibliographic entry see Field 06A. W70-03653

Control of Water on the Surface-Group 4A

EFFECTS OF FLOOD PROTECTION ON LAND THE COON CREEK, WISCONSIN, WATERSHED,

Wisconsin Bureau of State Planning, Madison. Donald F. Theiler.

Water Resources Research, Vol 5, No 6, p 1216-1222, Dec 1969. 7 p, 2 fig, 5 tab, 3 ref.

Descriptors: *Flood protection, *Small watersheds. *Land management, *Land use, *Wisconsin, Cost-benefit analysis, Planning, Soil conservation,

Identifiers: Coon Creek watershed (Wis)

In justifying small watershed projects under Public Law 566, the U.S. Soil Conservation Service (SCS) frequently counts as a benefit the intensified use of agricultural land resulting from increased flood protection. Actual land use changes in Wisconsin were far less than predicted by the SCS. The reasons are less related to the watershed project than they are to changes in farming practices. The adequacy of project evaluation techniques is questioned, and suggestions are made for improvement. (Knapp-USGS) W70-03654

USE OF THE CRITICAL PERIOD IN RESERVOIR ANALYSIS, California Univ., Los Angeles.

W. A. Hall, A. J. Askew, and W. W-G. Yeh. Water Resources Research, Vol 5, No 6, p 1205-1215, Dec 1969. 11 p, 4 fig, 3 tab, 4 ref. OWRR Project No B-061-CAL.

Descriptors: *Probability, *Streamflow forecasting, *Statistical models, Synthetic hydrology, Hydrograph analysis, Statistical methods, Hydrograph analysis, Meteorology, Reservoir management, Systems analysis.

Identifiers: *Critical period analysis, Synthetic hydrographs.

The 'critical period' in conjunction with reservoir design and operation is defined and an analysis is conducted of the usefulness of the concept in the evaluation of deficiencies of water for project planning purposes. Streamflow records from a number of rivers in the United States are analyzed, and certain defined characteristics of their various critical periods are derived. These characteristics are shown to be functions of both the active storage and the variation in annual streamflow. The dates of occurrence of the critical periods from historical records tend to be stable within certain geographic areas and over a range of active storages. Large numbers of equally likely hydrographs of the same length as the historical record were generated and compared with those found in the historical record. Some of the synthetic records produced critical periods in which the severity, measured by the decrease in the full record firm yield, was greater than the historical. However, the generated records as a whole had significantly less severity than the historical records of the same length. These observations suggest, but do not prove, that the more severe critical periods observed in historical records may be due to major perturbations of the cause-effect relationships not reflected by the hypothesis of static probability relationship. (Kmapp-USGS) W70-03655

FLOOD PLAIN INFORMATION, ARKANSAS RIVER, DODGE CITY, KANSAS. Corps of Engineers, Albuquerque, N. Mex.

Corps of Engineers Flood Plain Report, Dec 1969. 39 p, 7 fig, 13 plate, 7 tab.

Descriptors: *Floods, *Flood damage, *Kansas, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood. Identifiers: *Arkansas River, Dodge City (Kans), Standard project flood, Intermediate regional Flooding of the Arkansas River, Dodge City, Kansas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS) W70-03668

CORPORATE POWERS (REGULATION OF WATER SUPPLY - FLOOD CONTROL).

Pa Stat Ann tit 53, sec 3743 (1957).

Descriptors: *Pennsylvania, *Cities, *Flood protection, *Regulation, Cisterns, Levees, Navigable waters, Flood walls, Floods, Dams, Streamflow, Obstruction to flow, Rivers, Legislation, Administration, Administrative agencies, State governments, Docks, Piers, Supervisory control (Power), Construction, Operation and maintenance, Channel improvement, Reservoir construction, Reservoirs, Legal aspects. Identifiers: Ferries.

In addition to other powers granted by this act, the council of each city shall have the power to establish, make, fill and regulate public wells, cisterns, aqueducts, and reservoirs. Subject to the provisions of state law, the city councils may: (1) provide for the construction and maintenance of levees and ferries within the limits of the city; (2) erect wharves on navigable waters adjacent to the city, and regulate their use; (3) provide for protection against floods; (4) construct and maintain docks, retaining walls, dams or embankments; and (5) remove obstructions from, deepen and widen the channels of rivers and streams flowing through or adjacent to the city. (Barnett-Florida) W70-03685

STOCHASTIC ASPECTS OF RESERVOIR

STORAGE, Manchester Univ. (England). Inst of Science and Technology.
For primary bibliographic entry see Field 02A.
W70-03706

APPLICATIONS OF MONTE CARLO METHOD TO RESERVOIR DESIGN,

Institute of Water Resources Research, Berlin (East Germany). For primary bibliographic entry see Field 02A.

SIMULATION NUMERICAL WITHDRAWAL FROM A STRATIFIED RESER-VOIR.

Oregon State Univ., Corvallis, Oreg. For primary bibliographic entry see Field 08B. W70-03716

FOR WATERCOURSES (ALTERATION BRIDGE CONSTRUCTION).

Ohio Rev Code Ann secs 6151.01 thru 6151.13 (Page, 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Bridges, *Streams, *Bridge construction, Legislation, Benefits, Public benefits, Project benefits, Washouts, Road construction, Rivers, Alteration of flow, Damages, Costs, Estimated costs, Diversion, Administrative agencies, Condemnation, Financing.

When necessary for the proper protection of location of a proposed bridge or road, the board of county commissioners may divert, alter, straighten or clean out any watercourse, acquire the necessary property, and settle all claims for damages. Expenses are payable out of the funds for the bridge or road. Before the work is begun, a petition setting forth the benefits to be derived from the project and other necessary details must be filed with the county auditor. An engineer is appointed to determine whether the proposal is beneficial and to estimate the costs. All costs for the proceedings are paid from the bridge funds of the county. (Douberley-Florida) W70-03738

DRAINAGE AND LEVEE DISTRICTS.

Tenn Code Ann secs 70-735 thru 70-751 (1956), sec 70-752 (Supp 1969).

Descriptors: *Tennessee, *Drainage districts, *Local governments, *Assessments, Taxes, Drains, Levees, Cost repayment, Costs, Surveys, Damages, Engineers estimates, Project planning, Compensation, Coordination, Administrative agencies, Contracts, Watersheds (Basins).

Drainage districts may include land in more than one county. The clerk of the county court makes assessments for all lands in the district. The sufficiency and advisability of any petition for the establishment of a drainage district shall be determined by the county court after proper publication of notice. The court may require surveys and estimates of the costs of proposed improvements be-fore approving a petition. Drainage districts may cooperate and contract with other districts, with any state agency, or with the federal government. Drainage districts may exercise all the powers exercised by watershed districts. (Dearing-Florida) W70-03741

CORRECTION OF ERRORS IN ASSESSING DRAINAGE DISTRICT LANDS.

Tenn Code Ann secs 70-1001 thru 70-1007 (1956).

Descriptors: *Tennessee, *Drainage districts, *As-Descriptors: *Tennessee, Dialitage districts, Assessments, *Remedies, Legislation, Payment, Evaluation, Taxes, Tax rate, Boundaries (Property), Boundary disputes, Legal aspects, Administration, Administrative agencies, Administrative decisions, Appraisals, Damages.

Mistakes in assessments against landowners made by drainage district authorities may be corrected upon petition by the aggrieved landowners to the county court. Either the landowner or the district directors may appeal the court's assessment decision. No petition for correction of a mistake in boundaries will be heard after the decree fixing the number of acres has been confirmed and entered on the assessment roll. When an incorrect assess-ment has been made, the decree fixing such assessment shall not be final and any aggrieved party may petition the county court to correct the mistake. Upon a finding that a mistkae was made, all reports, decrees, blue prints, maps, and plats shall be points, decreas, blue prints, maps, and plats shall be amended accordingly. An appeal from such a decision may be made to the circuit court, where the cause will be heard de novo. (Schram-Florida) W70-03742

DRAINAGE DISTRICTS (CONSTRUCTION OF IMPROVEMENTS).

Tenn Code Ann secs 70-1201 thru 70-1232

Descriptors: *Tennessee, *Administrative agencies, *Drainage districts, *Drainage engineering, Drainage systems, Drainage practices, Controlled drainage, Drainage, Laterals, Outlets, Legislation, State governments, Administration, Channels, Legal aspects, Watercourses (Legal), Relative rights, Ditches, Drains, Assessments, Construction, Conveyance structures.

The county court is empowered to appoint members to the board of directors of drainage districts. Each board may enter into contracts for improve-

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A-Control of Water on the Surface

ments in its district. A bonded engineer is to be employed to supervise construction of improvements and to file monthly work estimates upon which compensation will be based. Each board is directed to employ a 'drainage overseer' to efficiently maintain improvements constructed within its district. The owner of any land assessed for construction costs of an improvement has the privilege of using the improvement, subject to the control and approval of the board of directors. The board for each district is required to settle disputes between landowners regarding use of lateral ditches or drains. Each board may assess damages for violations of this act. Assessments for improvements are to be collected as taxes but must be kept in a separate fund. Criminal penalties are imposed for injury to any drainage improvement. (Barnett-Florida) W70-03743

WATERS, DRAINS, AND LEVEES (DISTRICTS IN MORE THAN ONE COUNTY). Tenn Code Ann secs 70-1501 thru 70-1514

Descriptors: *Tennessee, *Drainage districts, *Administrative agencies, *Drainage practices, Drainage programs, Drainage systems, Local governments, State governments, Legislation, Regulation, Drainage engineering, Engineers esti-mates, Cost repayment, Administrative costs, Cost allocation, Construction, Assessments, Legal aspects, Project planning, Coordination, Administration, Permits.

Where a proposed drainage improvement is to be located in more than one county, application must be made to the county courts of each county. Upon application, a court appointed engineer will survey the entire area and report to each county in the dis-trict. The court is authorized to appoint viewers to assess damages to each county. County courts are directed to appoint commissioners to assess and apportion the costs of the proposed improvement. A board of directors for a district encompassing more than one county shall consist of one member from each one county shall consist of one member from each county. County courts retain the power to remove any commissioner, viewer, or director. An alternate method of establishing improvement or drainage districts lying in more than one county is provided. (Barnett-Florida)
W70-03744

SWAMP AND OVERFLOWED LAND. Mo Ann Stat secs 241.010 thru 241.130 (1952).

Descriptors: *Missouri, *Land reclamation, *Federal reclamation law, *Swamps, Patents, Legislation, Legal aspects, State governments, Standing waters, Surface waters, Reclamation states, Proprietary power, Public lands, Federal government, Conservation, Land development, Land management, Agricultural engineering.

Swamp and overflow lands were granted to the state of Missouri by an act of Congress entitled 'An act to enable the state of Arkansas and other states act to enable the state of Arkansas and other states to reclaim the swamp lands within their limits.' In order to provide for the reclamation of all overflowed and swamp lands, all Missouri lands are donated to the counties in which they may be situated. The duties of the Secretary of State, which include acting as swamp land agent, are enumerated. Title to all swamp or overflowed lands is conveyed by patent issued by the Secretary of State. The preparation, issuance and recordation of patents are regulated. All patents are prima facie evidence of title. (Powell-Florida)

SWAMP AND OVERFLOWED LANDS (PATENTS AND CONTRACTS). Mo Ann Stat secs 241.140 thru 241.240 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Swamps, *Patents, *Contracts, Control, Marshes, Surface waters, Land

reclamation, Wetlands, Legal aspects, Legislation, Contract administration, Regulation.

Control over patented swamp and overflowed lands is vested in the several county courts. Procedures involving the sale of swamp or overflowed lands by the county are provided. The conditions necessary for the county are provided. The conditions necessary for the cancellation of swamp or overflowed land sale contracts are enumerated. The clerk of the county court issues a patent for the swamp or overflowed land upon full payment by the purchaser. (Powell-Florida) W70-03757

SWAMP AND OVERFLOWED LANDS (RECLA-MATION AND ASSESSMENT OF DAMAGES). Mo Ann Stat secs 241.250 thru 241.280 (1952).

Descriptors: *Missouri, *Land reclamation, *Damages, *Overflow, Land, Legislation, Local governments, Swamps, Reclamation, Ditches, Levees, Drainage, Drainage systems, Administrative agencies, Payment, Surface drainage, Drainage programs, Judicial decisions, Legal aspects, Compensation. Assessments.

The county courts may appoint commissioners to superintend the surveying, draining, and reclama-tion of overflowed and swamp lands within the respective counties and may borrow money and issue bonds of the county for these projects. If the owners of any land through which any ditch or levee is proposed to be constructed or cut object to such construction, the commissioners shall obtain a summons for a jury to inquire into the damages the owners may sustain. A civil trial shall be conducted in a magistrate's court, and the jury's assessment of in a magistrate's court, and the jury's assessment of damages shall be specified in writing. If the county court determines that it is best to pay the damages, the money shall be paid to the landowner from the county treasury. If the objecting landowner refuses to accept the payment, the ditch or levee may be constructed, and the landowner shall be forever barred from maintaining any further action. Mali-cious destruction of any ditch or levee is a misdemeanor punishable by up to one thousand dollars fine and/or six months imprisonment. (Schram-Florida) W70-03758

ANNEXATION OF OLD DRAINAGE DISTRICTS BY NEW DRAINAGE DISTRICTS, Mo Ann Stat secs 242.692 thru 242.699 (Supp

Descriptors: *Missouri, *Drainage districts, *Outlets, *Boundaries (Property), Legislation, Legal aspects, Administrative agencies, Land tenure, Judicial decisions, Assessments, Taxes, Cost-benefit theory, Administration, Drainage systems. Identifiers: *Annexation, Reorganization.

The drainage districts whih desires to be annexed will be known as the minor district. The district to which the minor district desires to be annexed will be known as the major district. The board of super-visors of any minor district may petition any major district for annexation thereto providing the two districts have a common outlet or the major district has an outlet for the use of the minor district. The necessary contents of the petition are specified. The petition will be filed in the circuit court which incorporated the major district. The board of supervisors of the major district may either accept or reject the petition. If the petition is accepted, the clerk of the circuit court will publish notice thereof. Owners of land in the minor district may object to the petition and such objections will be heard in circuit court. The court will determine whether or not to issue a decree annexing the minor district to the major district. (Keith-Florida)

DRAINAGE DISTRICTS FOR MINING PUR-

Mo Ann Stat secs 242.700 thru 242.750 (1952).

Descriptors: *Missouri, *Drainage districts, *Land reclamation, *Mining, Administrative agencies, Mine drainage, Land tenure, Leases, Easements, Pumps, Pumping plants, Pumping, Watercourses (Legal), Planning, Excavation, Taxes, Financing, Surveys, Legislation, Right-of-way, Legal aspects, Mining engineering, Mineralogy. Identifiers: Underground watercourses.

When the state geologist certifies that certain lands are likely to contain valuable mineral deposits, owners of these lands may form a mining drainage district to drain their lands for mining purposes. district to drain their lands for mining purposes.
Such districts shall have the power to purchase,
construct, own or lease pumping plants in order to
promote the draining and reclamation of mineralized lands. The chief engineer of any mining district shall make a survey of mineralized lands and sub-mit a reclamation plan to the board of supervisors of the district outlining the methods of reclaiming the lands for mining purposes. The districts' projects shall be financed through the issuance of bonds and through the levy of a pumping tax on the gross value of mineral concentrates derived from the land. (Duss-Florida) W70-03761

CONSOLIDATION OF DRAINAGE DISTRICTS.

Mo Ann Stat secs 243.450 thru 243.540 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Drainage districts, *Administrative agencies, *Judicial decisions, Land tenure, Financing, Benefits, Assessments, Costs, Taxes, Construction, Legislation, Legal aspects. Identifiers: *Penalties (Criminal), Improvements.

Upon petition by one-fourth of the landowners in two or more drainage districts, such districts may reorganize into one district. Petitions shall be to the circuit court of the county containing the greatest acreage of land in the proposed district. Petitions shall contain descriptions of the land and districts involved. The clerk of the circuit court shall cause notice of the petition to be published. Any owner of real or other property in the proposed district, not signing the petition, may file objections to the petition which shall be reviewed by the court. Penalties are provided for officials who fail to carry out their duties to the district. The validity of bonds issued by districts shall not be questioned in any court, except for the power to issue such bonds. Suits on bonds for costs and performance of work shall be brought in the name of Missouri. Appeals from reorganize into one district. Petitions shall be to the brought in the name of Missouri. Appeals from county court decisions regarding drainage districts shall be to the circuit court. This chapter is remedial in character and drainage districts already in existence retain all powers heretofore granted by the state. Penalties for violations of this chapter are provided. (Duss-Florida)
W70-03762

CITY OF PORT RICHEY V ADAMEK (CONSTRUCTION OF A DOCK EXTENDING INTO A NAVIGABLE RIVER).

228 So 2d 428-431 (2d DCA Fla 1969).

Descriptors: *Boundaries (Property), *Docks, *Local governments, *Navigable rivers, Legislation, Judicial decisions, Ownership of beds, Beds under water, High water mark, Real property, Channels, Shores, Permits, Legal aspects, Boundary disputes, Water rights, Shallow water, Building codes, Structures, Construction, Land tenure, Cities, Navigation, Regulation.

Plaintiff, a property owner, requested the court to determine the boundary of his waterfront lot and to require defendant city to permit construction of a dock extending from his property into a navigable river. An approved plat of the sub-division revealed that plaintiff's property line extended forty-one feet into the river. A municipal ordinance permitted boat docks and piers to extend no more than 20 feet into a waterway from the property line. Defen-dant claimed that the proposed dock would extend more than twenty feet into the river and denied plaintiff's application for a building permit for that reason. The circuit court declared that plaintiff's property line was that shown on the plat and not the shoreline. Because the water immediately adjacent to the shoreline was shallow and non-navigable, the court held that the dock would not impede the natural flow of water, encroach upon the channel, or unduly restrict the use of the waterway by adjoining property owners. On appeal, the city claimed that Florida law permits private ownership of lands bordering on navigable waters only to the high water mark. The district court rejected this contention and affirmed the circuit court's decision, holding that construction of the proposed dock would not violate the city ordinance. (Schram-Florida) W70-03763

KOMMANVITTSELSKAPET HARWI V UNITED STATES (ACTION AGAINST FEDERAL GOVERNMENT FOR ALLEGED FAILURE TO MAINTAIN CHANNEL).
305 F Supp 882-895 (ED Pa 1969).

Descriptors: *Navigation, *Navigable rivers, *Admiralty, *Channels, Ships, Shoals, Warning systems, Depth, Buoys, Publications, Federal government, Administrative agencies, Legal aspects, Federal jurisdiction, Interstate rivers, Delaware River, Surveys, Channel improvement, Dredging, Damages, Charts, Judicial decisions, Remedies

Foreign shipowners brought this action for damages against the United States under the Suits damages against the United States under the Suits in Admiralty Act. Plaintiffs charged that negligence on the part of the United States government led to the grounding of their vessel on a shoal in the Delaware River. Specifically, they contended that the United States had assumed the duty of maintaining and surveying the channel in which the ship was damaged and that the United States negligently failed to notify users of the Delaware River that the existing channel could not sefety he used for existing channel could not safely be used for navigation. Plaintiffs alleged further that the United States negligently failed to publish informa-tion concerning the depth of the channel and failed to mark and alternate channel with temporary markers during channel construction. The court rejected these contentions, holding that even if the federal government has assumed the responsibility for regularly surveying and maintaining the chan-nel, there was no evidence that the government was nel, there was no evidence that the government was aware of the existence of the particular shoal in question. The court stated that even though the Corps of Engineers periodically publishes depth charts for certain channels, this does not justify navigators in relying upon the government to dredge and survey all channels in navigable interstate waterways. (Schram-Florida)

PARTITION WHEN LAND BOUNDED BY WATER. Wis Stat Ann sec 90.09 (1957).

Descriptors: *Wisconsin, *Boundaries (Property), *Boundary disputes, *Structures, Legislation, Negotiations, Rivers, Ponds, Streams, Legal aspects, Relative rights, Cost allocation, Cost sharing, Riparian land.
Identifiers: *Fences.

When the boundary line between enclosed lands of When the boundary line between enclosed lands of different persons is a river, brook, pond, or creek which does not form a sufficient fence, and it is impracticable because of unreasonable expense to build the fence on the true boundary line, and either owner refuses to join in making a partition fence on either side, application may be made to two fence viewers who will determine if the river, brook, pond, or creek is an insufficient boundary. If of determined, the viewers will put in writing how. so determined, the viewers will put in writing how, when, and where the fence is to be erected along with an assessment of cost to each of the disputing owners. This paper is filed with the town clerk and

recorded. If either party refuses or neglects to build his share of the fence, the other party may complete the fence and recover the expense thereof from the refusing party. If the viewers determine it impracticable to build any fence, written notice of such determination shall be given to the disputing parties. (Barnett-Florida) W70-03786

WISCONSIN FLOOD CONTROL AGENCIES.

Wis Stat Ann secs 87.12-87.18 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Administrative agencies, *Flood control, *Coordination, Legal aspects, Financing, Assessments, State governments, Reservoirs, Flood protection, Flood plains, Land tenure, Rivers, Maintenance, Operation and maintenance, Surveys, Leases, Construction, Construction costs, Repairing, Administration, Cities, Legislation, Cost allocation, Operating costs.

A Flood Control Board is hereby established to coordinate and supervise the construction, maintenance, and operation of flood control improvements authorized by the Department of Resource Development. The Board is authorized to: (1) contract for the construction of improvements; (2) enter upon lands to conduct surveys and examinations; (3) borrow money for reservoir construction; (4) sell or lease reservoirs; and (5) petition the Department for authorization to improve existing works. Penalties are provided for trespass upon, obstruction of, or interference with improvements. Leases, sales, and leases with options to purchase storage reservoirs may be secured only in accordance with the procedures herein established. Costs of maintenance and operation of flood control improvements are assessed against municipalities and owners of unincorporated land within the district. (Marsee-Florida) W70-03789

WISCONSIN FLOOD CONTROL.

Wis Stat Ann secs 87.01-87.11 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Flood control, *Administrative agencies, *Administration, Financing, Costs, Assessments, Dams, Dikes, Diversion, Flood protection, Levees, Reservoirs, Sewers, Ditches, Lakes, Rivers, Navigation, Floodways, Pumping plants, Siphons, State governments, Federal government, Legal aspects, Parks, Legislation, Channel improvement, Alteration of flow, Obstruc-

For purposes of flood control, the Department of Resource Development may straighten, widen, alter, or remove obstructions from any river, watercourse, lake, pond, creek, natural stream, ditch, course, lake, pond, creek, natural stream, ditch, drain, or sewer, and may concentrate, divide or divert the flow of water therein. However, no such work may substantially impair navigability. The Department may also construct, maintain, or remove ditches, canals, levees, dikes, dams, sluices, revetments, reservoirs, holding basins, floodways, pumping stations, sewers, siphons, and other works necessary for the purposes of this act. Procedures governing flood-work petitions and hearings are brown set forth, as are provisions relating to financherein set forth, as are provisions relating to financing, costs, assessment of benefits, collection of assessments and exemption of public parks from assessments. Public corporations or flood control sessments. Public corporations or flood control boards may enter into agreements with federal agencies to cooperate in the construction, operation or maintenance of any federally authorized project contemplated herein. Drainage area is defined. (Marsee-Florida) W70-03802

DRAINAGE MASTER PLAN FOR THE CITY OF FORT WORTH PUBLIC WORKS DEPARTMENT, STORM DRAINAGE CRITERIA AND DESIGN MANUAL.
Knowlton-Ratliff-English, Fort Worth, Tex.

For primary bibliographic entry see Field 08A. W70-03814

ON THE EXTREME VALUE DISTRIBUTION FOR DESCRIBING ANNUAL FLOOD SERIES, New South Wales Univ., Kensington (Australia). For primary bibliographic entry see Field 02E. W70-03854

A PEAK DISCHARGE RELATION FOR INTER-MEDIATE DRAINAGE BASINS,

Queen's Univ., Kingston (Ontario). For primary bibliographic entry see Field 02E. W70-03855

ESTIMATION OF STATISTICAL PARAMETERS FOR ANNUAL RIVER FLOWS,
Universidad Nacional del Zulia, Maracaibo

(Venezuela).

For primary bibliographic entry see Field 02E. W70-03858

COMPARISON OF SMART AND SCHEIDEGGER STREAM LENGTH MODELS, IBM Watson Research Center, Yorktown Heights,

For primary bibliographic entry see Field 02E. W70-03862

FLOOD PLAIN INFORMATION, LOOKING-GLASS RIVER, CLINTON COUNTY, MICHIGAN. COUNTY, Corps of Engineers, Detroit, Mich.

Prepared for Water Resources Comm, Mich Dept of Natural Resources and Tri-County Regional Planning Comm. Corps of Engineers Flood Plain Report, Dec 1969. 43 p, 8 fig, 34 plate, 12 tab.

Descriptors: *Floods, *Flood damage, *Michigan, Flood plains, Flood control, Non-structural alter-natives, Maximum probable flood, Historic flood. Identifiers: *Clinton County (Mich), Standard pro-ject flood, Intermediate regional flood.

Flooding of the Lookingglass River, Clinton County, Michigan is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may he expected to occur in the future. The information be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS) W70-03868

EVALUATION OF EXCEEDANCE PROBABILITY OF FLOOD FOR FLOOD-PROTECTION WORKS IN RIVER,

Kyoto Univ. (Japan). Disasters Prevention

Research Inst. Yasuo Ishihara, and Masashi Nagao.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 69, p 556-564, 1967. 9 p, 7 fig, 2 ref.

Descriptors: *Water management (Applied), *Streamflow forecasting, *Reservoir design, *Reservoir operation, *Statistical methods, Probability, Regulation, Flood protection, Flood forecasting, Statistical models, Peak discharge, Rainfall-runoff relationships.

Identifiers: Drainage basin management.

There are many factors to be taken account of in designing various water works such as reservoirs and embankments, in which the hydrological quantities become the dominant factor. In estimating the occurrence probabilities of the quantities, multi-dimensional consideration is preferable to

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

the one-dimensional. The theoretical method of estimation of the exceedance probability by using the two-dimensional probability theory of normal distribution is discussed. The theoretical deduction of the joint exceedance probability is given and several methods available for estimation of the probability for the case where there are a floodcontrol reservoir and an embankment reach, are presented. As the results of this approach, it is shown that the exceedance probability taking account of the correlation among the related factors becomes smaller than that of the independent events. (Knapp-USGS) W70-03886

PURPOSE AND PERFORMANCE OF PEAK PREDICTIONS,

Pennsylvania State Univ., University Park, Pa. Dept. of Civil Engineering; and Colorado State Univ., Fort Collins. Dept. of Civil Engineering. Brian M. Reich.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 70, p 565-572, 1967. 5 fig, 2 tab, 8 ref. Bureau of Land Management Contract No 14-11-0008-0590-62

*Small Descriptors: *Flood forecasting, *Small watersheds, *Statistical methods, *Peak discharge, Rational formula, Hydrologic budget, Rainfall-runoff relationships, Runoff forecasting, Streamflow forecasting, Evaluation.
Identifiers: Flood prediction formulas.

Five current methods for estimating flood peaks expected from ungaged rural drainages of small areas are discussed. Predictions are made with the 5 methods on 45 streams at 19 locations widely spaced across the United States. The methods were tested in arid as well as non-arid regions, beyond the geologic zones for which they were developed, and according to other criteria in a search for adaptability and generality. The scatter resulting from these considerations of 134 observed floods is discussed in the light of requirements and restrictions imposed by the authors of design techniques. Diagrams and statistics illustrate the uncertainties involved and show which methods under- or overpredict for this sample from nature. (Knapp-USGS) W70-03887

DISCRIMINATING THE CHANGE IN MEANS OF HYDROLOGIC VARIABLES,

Colorado State Univ., Fort Collins. Dept. of Civil

Engineering. Radmillo D. Markovic.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 72, p 581-588, 1967. 8 p, 3 fig, 4 ref. Bureau of Reclamation Contract No 14-06-D-5299.

Descriptors: *Streamflow forecasting, *Statistical methods, *Reviews, Regression analysis, Probability, Stochastic processes, Stage-discharge relations. Identifiers: Streamflow probability.

Significant natural or manmade changes of climatic, physiographic, and other conditions influencing hydrologic phenomena may cause the sample means of hydrologic variables describing these phenomena to change. The statistical methods for discriminating these changes in the means of hydrologic variables are discussed. The methods were derived by employing either the target or target-control concept and by applying the univariate, bivariate, or conditional distribution function of target and control hydrologic variables. Each of the methods presented here may be applied under specified particular conditions. (K-napp-USGS)
W70-03888

ERRORS IN DISCHARGE ESTIMATES ON MOUNTAIN STREAMS, Ontario Agricultural Coll., Guelph. School of

Agricultural Engineering.
For primary bibliographic entry see Field 02A.
W70-03889

DELTA AND PINE LAND CO OF MISSISSIPPI V BOARD OF SUPERVISORS OF BOLIVAR COUNTY (LEASING OF LEVEE DISTRICTS LAND).

228 So 2d 893-896 (Miss 1969).

Descriptors: *Mississippi, *Levees, *Leases, *Administrative decisions, Bids, Floods, Alluvium, Flood control, Flood protection, Legislation, Administrative agencies, Real property, State governments, Land management, Mississippi River, Jurisdiction, Legal aspects, Contracts, Land tenure,

Judicial decisions.
Identifiers: *Alluvium lands, *Levee districts.

Pursuant to a special statute regulating the leasing of lands within levee districts, the Board of Supervisors leased two sections of land to the person who had submitted the highest sealed bid. The holder of the previous leases appealed the order of the Board, contending that because they submitted bids in excess of the highest sealed bids after learning the amount thereof, they were entitled to the leases. The Supreme Court of Mississippi affirmed the Board's order and held that the regulatory statute was not unconstitutional for failing to give preference to previous leaseholders. Appellant pointed out that another statute regulating the leasing of government lands contained provisions for giving preference to previous leaseholders, and contended that the statute should be applied to this leasing arrangement. Rejecting this contention, the court held that the state had legitimately classified lands composed of alluvium soil into levee districts. and the special statute regulating the leasing of 16th section lands located within these districts should control. Alluvium lands are defined as those built by deposits of sediment from streams and floods. (Schram-Florida) W70-03907

COSTS AND MAINTENANCE OF DRAINAGE DISTRICTS.

Mo Ann Stat secs 243.320 thru 243.440 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Administrative agencies, *Drainage districts, *Financing, Legislation, Ditches, Drains, Levees, Maintenance, Maintenance costs, Costs, Cost allocation, Benefits, Taxes, Construction, Boats, Dredging, Assessments, Excavation, Land tenure, Real property, Regulation, Railroads, Roads. Identifiers: Penalties (Civil), Dredge boats, Liens.

The cost of drainage ditches shall be apportioned to the entities owning the public roads of railroads which are benefitted. The county court has the duty to levy a maintenance tax to maintain the work of the drainage district. A portion of this tax may be set aside for the purchase of dredge boats, tools, or other machinery necessary for maintenance of the drainage district. Various provisions outline the payment of drainage taxes for district improvements and the method of administering the maintenance tax. All drainage taxes including maintenance taxes, penalties, and costs of collection constitute liens upon the property taxed until the taxes are paid. The county court may prorate surplus funds back to the taxpayers or use them for maintenance in lieu of maintenance taxes. The county court may issue bonds to finance the costs of drainage improvements. Regulations regarding the issuance of bonds are provided. Such bonds may be pledged to any corporation, commission or agency created or authorized by Congress or the state of Missouri. (Duss-Florida)

DRAINS, DRAINAGE PROCEEDINGS, AND DRAINAGE DISTRICTS.

Wis Stat Ann secs 88.01, 88.03, 88.08, 88.09, 88.12-88.17 (Supp 1969).

Descriptors: *Wisconsin, *Drainage, *Drainage districts, *Drains, Regions, Governments, State governments, Administrative agencies, Legal aspects, Costs, Cost allocation, Jurisdiction, Drainage engineering, Drainage programs, Administration, Tiles, Pipes, Pumping, Ditches, Water control, Legislation, Drainage practices, Water conveyance, Supervisory control (Power), Diversion, Surface drainage, Surface runoff.

Drainage proceedings are quitable in nature. The county court maintains supervisory control over the actions of the drainage board, and may require the board to submit reports of its proceedings. Provision is made for the taxing of costs in drainage proceedings. Decisions of the drainage board may be appealed to the supreme court of the state. When a proposed drainage area covers portions of more than one county, the county containing the greatest acreage proposed for drainage has jurisdiction over the organization and operation of the dis-'Drain' means any device used for the drainage of water from land or the protection of land from surface water, including open ditches, tiles, pipelines, pumps, and levees. (Marsee-Florida)
W70-03920

RESERVOIR SYSTEM DESIGN OPTIMIZA-

Esso Research and Engineering Co., Florham Park, N.J. Environmental Control. Richard J. Butsch.

Proceedings of ASCE, J Hydraul Div, Vol 96, No HY 1, p 125-130, Jan 1970. 1 tab, 8 ref, 2 append.

Descriptors: *Optimization, *Reservoir design, *Linear programming, *Dynamic programming, *Decision making, Locating, River basins, Size, Benefits.

Identifiers: Operating Criteria.

The optimization of a reservoir system by the use of selective mathematical techniques was discussed. A method was described by which optimum sizes, number and locations of reservoirs in a river basin could be determined. A variety of optimization techniques were used to evaluate promising designs on the basis of greatest economic benefits. Three levels of decision were required: (a) choosing the number and locations of reservoirs, (b) choosing size and operating criteria, and (c) the optimizing operation. Each level was optimized in turn, the op-timization of lower levels being nested within imization of lower levels being nested within higher ones. Techniques were chosen on the basis of their efficiency in each part of the design. Linear programming was used to optimize operations, dynamic programming used to optimize total benefits and optimize seeking methods used for optimizing decision variables. (Thiuri-Cornell) W70-03941

WATER RESOURCE DEVELOPMENT IN CALIFORNIA: THE COMPARATIVE EFFICIENCY OF LOCAL, STATE AND FEDERAL AGENCIES,

California Univ., Berkeley. Joe S. Bain,

Water Resources Management and Public Policy, Seattle, University of Washington Press, p 12-29, 1968.18 p.

Descriptors: *Economic efficiency, *Water resource development, Local government, State resource development, Local government, State government, Federal government, Surface waters, Water allocation, Hydrology, Water usage, Economic evaluation, Water supply, Water demand, Water transfer, Public utilities, Irrigation, Flood control, Dams, Reservoirs, River-basin development, Prices, Average cost, Water districts, Cost-benefit analysis, Interest rate, Discount rate. Identifiers: *Central Valley, Local agencies, State agencies, Federal agencies. agencies, Federal agencies.

Groundwater Management—Group 4B

Findings are reported concerning the development of surface waters of the Central Valley of Califor-nia. Chief concern are the quality of the per-formance of local, state and federal water agencies with respect to the level of water resource development and the allocation of water among types, sites and times of use. Discussion is concerned with the economic efficiency in these respects of local water agencies as one group and the federal agencies together with the California Department of Water Resources as another. It also brings out some apparent historical and structural reasons for differentials in economic efficiency between the two groups of agencies. The best case for comprehensive river-basin development by a central agency is where appreciable settlement and prior water development is absent. (See W70-03995). (Murphy-Rutgers) W70-03997

DRAINAGE DISTRICTS ORGANIZED COUNTY COURT.

Mo Ann Stat secs 242.240 thru 243.310 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Drainage districts, *Surface drainage, *Management, Legislation, Legal face drainage, "Management, Legislation, Legal aspects, Drains, ditches, Levees, Maintenance, Repairing, Construction, Watercourses (Legal), Laterals, Outlets, Taxes, Costs, Cities, Leases, Benefits, Damages, Cost-benefit theory, Financing, Administration, Assessments, Jurisdiction, Supervisory control (Power), Operation and maintenance.

Identifiers: Bonds.

The county courts are charged with the management and control of all drainage districts, existing or hereafter organized. The courts have the duty and power to maintain, preserve, restore, repair, strengthen, and replace the drains, ditches, and levees of the districts. Any person may construct lateral ditches or drains for the purpose of draining water into any district ditch, drain or watercourse, provided such lateral ditch or drain enters the district ditch, drain enters the district ditch, drain enters the district ditch, drain, or water-course through boxes or tiling placed at the intersection of the ditches. Drainage districts may contract with any city to furnish an outlet for the drainage of such city. The court can require one district to lease its equipment to another district. After the incorporation of a district, the court will levy a special tax of no more than fifty cents per acre on each acre of land within the district to pay for district organization and any other necessary expenses to be incurred before the court may levy taxes or issue bonds to provide funds to pay for district improvements. Ordinary taxes will be levied on the land in porportion to the benefits received. (Keith-Florida)

LEVEE DISTRICTS.

Mo Ann Stat secs 245.455 thru 245.545 (1959).

Descriptors: *Missouri, *Levees, *Flood protection, *Project planning, Legal aspects, Legislation, Engineering structures, Flood control, Assessments, Engineers estimates, Administrative agencies, Construction, Appropriation, Swamps, Conservation, Drainage practices, Diversion, Diversion structures, Barriers.

Landowners within the levee district determine which new projects or repairs will be undertaken by the district. They are to base their decision in part upon the reports and estimates of the engineer and upon assessments by district assessors for the probable costs of the work. The board of directors for a levee district may call a meeting of the landowners in the district whenever the board ascertains that the levees constructed by the district are insufficient to afford complete protection from overflows. The board may recommend the strengthening and enlarging of the levees at this meeting. The procedures for the construction and improvement of levees are prescribed. The county court may appropriate swamp lands belonging to the county for the purpose of constructing a levee. (Powell-Florida) W70-04021

THIRD CLASS CITIES.

Mo Ann Stas secs 77,140, 77,150 (1952).

Descriptors: *Missouri, *Cities, *Channel improvement, *Mineral water, Legislation, Condemnation, Reservoirs, Flood protection, Lakes, Dams, Dam construction, Parks, Local governments, Pipelines, Construction, Municipal water, Springs, Cisterns, Engineering structures, Hydrau-lic structures, Well regulations, Wells, Water wells, Taxes, Costs, Profit, Channels, Supervisory control

The councils of third class cities are authorized to establish, alter and change the channel of watercourses. They may prevent obstructions of channels and may establish and regulate public wells, cisterns and reservoirs of water. The city councils may purchase land and provide for the establishment of public parks. The mayor and council of third class cities are authorized to acquire by gift, purchase, or condemnation all necessary or desirable lands for the construction of dams, lake and flood protection systems, bathhouses, and mineral water vending houses. They may also acquire lands for the laying of pipelines for the distribution of mineral waters. They may improve and operate mineral springs and wells and construct all necessary buildings and works for the purpose of maintaining these properties as revenue producing public projects. These properties may be leased or conveyed for this purpose. These projects shall not be acquired, constructed or maintained by either general or special taxes. (Schram-Florida) W70-04037

CITIES OF THIRD CLASS (POWER TO REGU-LATE LEVEES).

Mo Ann Stat secs 77.530, 77.540 (1952).

Descriptors: *Missouri, *Local governments, *Levees, *Regulation, Diseases, Legislation, Human diseases, Public health, Environmental sanitation, Epidemics, Municipal wastes, Condemnation, Sewers, Cities, Outlets, Conveyance structures, Disposal, Water works, Hospitals, Railroads, Docks, Supervisory control (Power), Legal aspects.
Identifiers: *Quarantines.

The councils of third class cities are authorized to enact ordinances for the prevention and abatement of contagious diseases. The councils may purchase or condemn all necessary lands within ten miles of the city for hospital purposes, waterworks, sewer carriage and outfall. They may make regulations to secure the general health of the city and to prevent and remove nuisances. The councils are authorized to regulate levees, wharves, landings, and depots. (Schram-Florida) W70-04038

4B. Groundwater Management

UPCONING OF FRESH WATER-SEA WATER
INTERFACE RELOW PUMPING WELLS. INTERFACE BELOW PUMPING FIELD STUDY,

Ministry of Agriculture, Jerusalem (Israel). Hydrological Service; and Water Planning for

Israel Ltd., Tel-Aviv.
S. Schmorak, and A. Mercado.
Water Resources Research, Vol 5, No 6, p 1290-1311, Dec 1969. 22 p, 24 fig, 1 tab, 11 ref.

Desriptors: *Saline water intrusion, *Aquifers, *Saline water-freshwater interfaces, *Water level fluctuations, Encroachment, Mixing, Diffusion, Dispersion, Groundwater movement, Pumping, Withdrawal, Mathematical models, Mathematical

Identifiers: Nomograms, Cone of depression.

Field investigations on the upconing mechanism of interface under the influence of pumping were carried out to check the validity of the existing theoretical formulas, to study the salinization of pumped water as related to the position and characteristics of the interface, and to provide some analytic design procedures for skimming fresh water from above saline water bodies. Exist-ing theoretical formulas describing the upconing interface are in agreement with field results up to some critical rise of the interface, which seems to be approximately half the distance between the bottom of the well and the undisturbed interface. In addition, the use of the linear approximation for the dispersion pattern was justified as a first approximation of the resultant transition zone. The salinization of the pumped water is probably caused by the intrusion of saline water above a critical depth. From correlation analysis, the salinity increase of pumped water is about 5 to 8% of the average salinity of the saline water intruded above the critical depth. Design procedures based both on theoretical formulas and field investigations are summarized in the form of nomograms. These nomograms were constructed on the assumption that the mixing mechanism for other geometries is similar to the observed one. (Knapp-USGS) W70-03677

COST, PRECISION, AND VALUE RELATION-SHIPS OF DATA COLLECTION AND DESIGN ACTIVITIES IN WATER DEVELOPMENT PLANNING,

PLANNING,
California Univ., Berkeley. Hydraulic Lab.
Stephen V. Allison.
Hydraulic Lab Tech Rep 6-27, Univ of Calif,
Berkeley, Water Resources Center, Contrib No
120, May 1967. 142 p, 12 fig, 17 tab, 24 ref, 3 ap-

Descriptors: *Mathematical models, *Optimization, *Water resources development, *Planning, *Decision making, Costs, Design, Data collections, Reservoirs, Budgeting, Constraints, Groundwater,

The problem of allocating available resources between the many diverse activities required in water development planning was presented. The problem could be formulated either in terms of maximizing overall precision subject to a fixed budget constraint, or minimizing the cost of attaining a specified degree of overall precision. A method of solution based on mathematical decision techniques was proposed and tested on the activities involved in the modelling of groundwater reservoirs. These concepts were used to build a mathematical model of the groundwater reservoir underlying the southern end of the San Joaquin Valley in California. Optimal programs of collecting and manipulating the required data were defined and the applicability of mathematical decision techniques to the solution of these problems was demonstrated. (Thiuri-Cornell)

SELECTED ANALYTICAL METHODS FOR WELL AND AQUIFER EVALUATION, Illinois State Water Survey Div., Urbana. William C. Walton.

State Water Survey Div, Urbana, Ill, Bulletin 49, 1962. 81 p, 76 fig, 25 tab, 165 ref, 6 append.

Descriptors: *Mathematical models, *Aquifer characteristics, *Wells, *Hydrologic budget, *Illinois, Groundwater, Simulation analysis, Optimization, Geohydrologic units, Recharge, Pumping, Well spacing.

Identifiers: Image-well theory.

The practical application of selected analytical methods and mathematical models to well aquifer evaluation problems in Illinois was described. The subject matter included formulas, methods and models used to quantitatively appraise the geohydrologic parameters affecting the water-yielding capacity of wells and aquifers, and their response to heavy pumping. Several methods for

Field 04-WATER QUANTITY MANAGEMENT AND CONTROL

Group 4B—Groundwater Management

evaluating recharge rates involving flow-net analysis and hydrologic and groundwater budgets were described in detail. Optimum well spacings were estimated taking into consideration aquifer characteristics and economics. Simulation analysis techniques were used to formulate a model aquifer. The image-well theory and the appropriate groundwater formulas were used to construct a mathematical model which provided a means of evaluating the performance of wells and aquifers. (Thiuri-Cornell) W70-03943

4C. Effects on Water of Man's Non-Water Activities

SOME EFFECTS OF SHADE COVER ON STREAM TEMPERATURE IN SOUTHEAST ALASKA,

Forest Service (USDA), Juneau, Alaska. Pacific Northwest Forest and Range Experiment Station. For primary bibliographic entry see Field 05G. W70-03819

THE WATER-RESOURCE COMMUNICATIONS

GAP, For primary bibliographic entry see Field 06D. W70-03841

4D. Watershed Protection

WATERSHED DISTRICTS.

Tenn Code Ann secs 70-1801 thru 70-1849 (Supp 1969).

Descriptors: *Tennessee, *River basin commissions, *Watershed management, *Administrative agencies, Legislation, Drainage, Projects, Erosion control, Legal aspects, Construction, Maintenance, Water conservation, Land management, Water control, Water utilization, Drainage systems, Flood control, Water management (Applied), Reservoir construction, Reservoirs, Dikes, Levees, Recreation facilities.

Each watershed district is authorized to conserve soil and water and to retard floods and develop the water resources of the district. Watershed districts contract for the construction of proposed works and improvements. Watershed districts are empowered to construct drainage works or improvements and any works or improvements for the control, retention, diversion, or utilization of water. The watershed districts have authority to: retard runoff of water and soil erosion; construct ditches, channel improvements, dikes, levees, flood prevention reservoirs, water conservation reservoirs, irrigation reservoirs, facilities, parks, and other recreational facilities; and to repair, improve, and maintain any of said improvements or structures. A district may acquire land by gift, purchase or eminent domain. A district may acquire water rights and distribute or sell water for irrigation or other purposes. A district may provide recreational other purposes. A district may provide rectreations facilities. A study of the watershed area is conducted upon the incorporation of a watershed district. The matters to be determined by the court at a hearing on a petition for organization of a watershed district are enumerated. (Powell-Florida) W70-03772

SEDIMENT YIELDS FROM THE CENTRAL COLORADO SNOW ZONE, Forest Service (USDA) Fort Collins, Colo. Rocky

Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 2J. W70-03821

WATERSHED DISTRICTS.

Ohio Rev Code Ann secs 6105.01 thru 6105.99 (Page Supp 1970).

Descriptors: *Ohio, *Watershed management, *River basin commissions, *Water management (Applied), State governments, Legislation, Administrative agencies, Water utilization, Channels, Water zoning, Water districts, Public utility districts, Conservation, Permits, Regulation, Channel improvement, Floodways.

Administrative Organization, Identifiers: procedures.

Terms dealing with watershed districts including water resources, beneficial use, channels and restricted channels are defined. Procedural details are outlined for establishing watershed districts. The board of directors of the district is empowered to: (1) review and recommend plans for the development of water resources; (2) recommend means of resolving conflicts between water users; (3) make studies and review plans for the development of water resources; (4) prepare a comprehensive plan for beneficial use of water to submit to state agencies; (5) counsel and advise public agencies on water problems; (6) enter contracts; (7) issue permits to restrict certain floodways; (8) issue construction permits for alteration of any floodway; and (9) petition for the creation of a conrequired before building any dam or boring any well. Certain areas may be designated as restricted channels. (Barnett-Florida)

SOIL AND WATER CONSERVATION DIS-

Wis Stat Ann secs 92.02-92.05, 92.08, 92.14, 92.15 (1957), as amended, (Supp 1969) 92.18, 92.20 (Supp 1969).

Descriptors: *Wisconsin, *Soil conservation, *Ero-Descriptors: *wisconsin, *Soli conservation, Listing sion control, *Administrative agencies, Legal aspects, Legislation, Agricultural engineering, Sediment control, Soil erosion, Water conservation, Soil management, Soil stabilization, Flood control, Operation and maintenance, Land tenure, Agriculture, Coordination, State governments, Watershed management, Surface runoff, Flood protection, Drainage.

The Soil and Water Conservation Committee is hereby established to conserve the soil resources of Wisconsin and to prevent damage to the soil from erosion, sediment, or floodwater. The Committee is directed to assist supervisors of soil conservation districts, approve and coordinate the activities of the districts, and disseminate information concerning soil conservation. County boards of supervisors may establish soil conservation districts. These districts are empowered to acquire property for watershed protection. flood prevention works, and recreational improvements. The districts may carry out measures for flood prevention or for agricultural phases of water control including the construction and operation of any necessary strucutres. Soil conservation districts are authorized to develop comprehensive plans for soil conservation and water utilization, enter lands to make surveys, and provide landowners with equipment, fertilizers, seeds and seedlings for soil conservation purposes. Provision is made in the act for the discontinuance of the districts. State agencies are instructed to cooperate with the districts in matters related to soil conservation. (Marsee-Florida) W70-03918

MISSOURI SOIL AND WATER CONSERVA-TION DISTRICTS LAW. For primary bibliographic entry see Field 03D.

05. WATER OUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

USER TRIALS OF A SUBMERSIBLE WATER QUALITY RECORDING METER, Ontario Water Resources Commission, Toronto. Great Lakes Survey Program.

Ontario Water Resources Commission, Great Lakes Surveys Program, 1969. 32 p, 6 fig, 2 tab, 5 ref, 5 append.

Descriptors: *Water quality, *Monitoring, *Instrumentation, Water pressure, Water temperature, Hydrogen ion concentration, Turbidity, Conductivity, Dissolved oxygen.
Identifiers: Water quality meters.

Two submersible recording water quality meters were field tested in the Great Lakes for accuracy were field tested in the Great Lakes for accuracy and stability. These meters are battery operated and completely self-contained in a sealed stainless steel tube 16.5 cm in diameter by 76.2 cm long, weighing 21 kilograms. Temperature, pressure, real time, turbidity, pH, conductivity and dissolved oxygen are automatically evaluated every five minutes to one hour and recorded on magnetic tape. The information can also be transmitted to the water surface via line for telemetering. The meters have proven to be both flexible and reliable in water quality monitoring and model development programs. (Knapp-USGS) W70-03662

DIEL AND SEASONAL VARIATIONS IN PHYSIOCHEMICAL LIMNOLOGY, SPEED

RIVER, ONTARIO, Guelph Univ. (Ontario). For primary bibliographic entry see Field 02K. W70-03861

COMPARISON STUDIES OF WINKLER VS. OXYGEN SENSOR.

Decatur Sanitary District, Ill.

Jeremiah F. Reynolds.
Journal Water Pollution Control Federation, Vol 41, No 12, p 2002-2009, Dec 1969. 8 p, 8 tab, 7 ref.

Descriptors: *Dissolved oxygen, *Water analysis, *Laboratory tests, Water quality, Instrumentation, Monitoring, Sewage treatment, Waste treatment. Identifiers: Dissolved oxygen sensor.

Determinations of dissolved oxygen levels in waste-water treatment and effluent disposal are of great use in a number of ways. In-plant laboratory studies of using a polarographic oxygen sensor in comparison with the more common Winkler method were conducted. Advantages found were (a) the preparation and standardization of reagent solution are eliminated; (b) time spent in analysis is reduced; (c) the method is less tedious; and (d) correlation with the Winkler method is excellent. Laboratory experiences and data support these conclusions. (Knapp-USGS) W70-03876 W70-03876

A BREAKTHROUGH IN THE TRACER STU-DIES OF SEDIMENTATION TANKS, Nova Scotia Technical Coll., Halifax. Dept. of Civil

Engineering. For primary bibliographic entry see Field 05D. W70-03922

SURFACE SLICKS AS CONCENTRATORS OF PESTICIDES IN THE MARINE ENVIRON-MENT,

MENT, Miami Univ., Fla. Inst. of Marine Sciences. Douglas B. Seba, and E. F. Corcoran.

Pesticides Monitoring Journal, Vol 3, No 3, p 190-193, 1969. 1 fig, 2 tab, 21 ref.

Descriptors: *Pesticides, *Surface waters, Oceans, Distribution, Florida, DDT, Winds, Dusts, Fish, Gulls, Plankton, Ecology, Productivity, Photosynthesis, Dieldrin, Aldrin, Flood control, Canals, Sampling, Farm wastes.
Identifiers: *Marine environment, *Slicks, *Con-

centrators, Biscayne Bay (Fla), Florida Current, DDE, Barbados (West Indies), Clupeidae, Engraulidae, Dolphins, Miami River (Fla), Turkey Point (Fla), Acetone, Butyraldehyde, Leptopel, Trade winds

Slicks, or calm streaks on a rippled sea, are often seen on coastal waters and lakes and have been ob-served throughout the oceans. Formed by the rip-ple-damping action of a surface film of organic matter which occurs naturally on biologically reproductive waters, they are effective concentra-tors of persistent chlorinated pesticides and in-dicate presence of pesticides when they are undeterminable in surrounding waters. Because of high biological activity associated with slicks and their occurrence in oceans, these findings may be of considerable importance in understanding pesticide distribution in the marine ecosphere. Pesticides apparently exist in very low concentration in open oceans. Findings that acetone, butyraldehyde and 2-butanone, common to all samples, were barely concentrated, if at all, while pesticides were concentrated by several orders of magnitude, demonstrate that slick enrichment is a highly selecdemonstrate that slick enrichment is a highly selective fractionation and may be of considerable ecological importance. Biological activity was very intense in water immediately under the slicks in comparison to surrounding water. Slicks could often be located by noting the feeding of sea gulls on fish. (Jones-Wisconsin) W70-03953

IRON IN NATURAL WATERS--ITS CHARACTERISTICS AND BIOLOGICAL AVAILABILITY AS DETERMINED WITH THE FERRIGRAM,

Minnesota Univ., Minneapolis. Limnological Research Center.

For primary bibliographic entry see Field 02K. W70-03954

ECOLOGY OF YEASTS FROM LAKE CHAM-

PLAIN, Georgia State Coll., Atlanta; Louisiana State Univ., Baton Rouge; State Univ., Coll., Plattsburgh, N.Y.; and Vermont Univ., Burlington. D. G. Ahearn, S. P. Meyers, W. L. Cook, and G.

Hansen.

Antonie van Leuuwenhock, Vol 35, Supplement: Yeast Symposium, p D19-D20, 1969. 3 ref.

Descriptors: *Ecology, *Yeasts, New York, Vermont, Depth, Fungi, Nitrates, Temperature, Sampling, Effluents, Mills, Methane, Sludge, Iced lakes, Hydrography, Density, Pollutants, Oxygen, Light intensity, Thermal water. Identifiers: *Lake Champlin (NY), Cryptococcus albidus, Rhodotorula rubra, Endospores, Rhodotorula glutinis, Aureobasidium pullulans, Cephalosporium, Hyalodendron, Rhinocladiella, Particulate matter, Candida krusei. Trichosporon Particulate matter, Candida krusei, Trichosporon

penincillatum, Saccharomyces, Pichia, Trichoderma viride, Cellobiose, Hansenula californica, Hanseniaspora uvarum, Anionic alkylbenzene sulfonates, Cellulolytic fungi, Yeast distribution, Paper mill wastes, Water pollution identification.

Fifty-seven water samples collected from Lake Champlain, New York (August 1968) showed that yeasts and yeast-like fungi occurred randomly from the surface to depths of 115 meters, usually in concentrations yielding less than five colonies per 100 milliliters. Their highest concentrations generally occurred near the surface, but at some stations 15 to 70 cells/100 milliliters were found at intermediate and lowest depths. Most widespread fungi were representatives of Cryptococcus albidus, Rhodotorula rubra, R glutinis, and Aureobasidium

pullulans while inshore sites appeared to possess distinct populations. Highest yeast densitities (more than 400 cells/100 milliliter) were observed at stations receiving heated effluents from a paper mill, with large numbers of a yeast not observed elsewhere. Animal associated yeasts were rarely isolated from urban areas. Regions influenced by urban sewage yielded predominantly Hansenula californica and Hanseniaspora uvarum. Monthly samples demonstrated that yeast populations were present throughout the year with maximal densities occurring during two successive winters, occasionally under iced conditions. No correlations were observed between yeast densities and various hydrographic conditions. Distributive patterns of certain species suggest the feasibility of using yeasts as indicators of specific water pollutants. (Jones-Wisconsin) W70-03962

BACTERIAL GROWTH RATE IN THE SEA: DIRECT ANALYSIS BY THYMIDINE AUTORADIOGRAPHY,

Indiana Univ., Indianapolis. Dept. of Microbiology. For primary bibliographic entry see Field 05C. W70-03968

5B. Sources of Pollution

STATISTICAL EVALUATION OF SALINITY AND NITRATE CONTENT AND TRENDS BENEATH URBAN AND AGRICULTURAL AREA-FRESNO, CALIFORNIA,

Agricultural Research Service, F Groundwater Recharge Field Station. Fresno, Calif.

Harry I. Nightingale.
Groundwater, Vol 8, No 1, p 22-28, Jan-Feb 1970.
7 p, 6 fig, 5 tab, 8 ref.

Descriptors: *Water pollution sources, *Groundwater, *California, *Nitrates, *Salinity, Water wells, Aquifers, Irrigation water, Fertilizers, Urbanization, Statistical methods, Surveys, Conductivity, Farm wastes, Regression analysis Identifiers: Fresno (Calif).

The salinity and nitrate content of well water for an urban zone (Fresno-Clovis, California) and the immediate surrounding irrigated agricultural zone were compared using data for 1950 through 1967. Time trends in these water chemical properties were evaluated statistically by dividing the 18-year period into three 6-year periods. Salinity of the urban zone groundwater has increased with time, whereas that of the agricultural zone has fluctuated considerably. Possible reasons for changes are discussed. The nitrate content of well water from both zones has increased with time, with water from the agricultural zone showing the greatest increase. (Knapp-USGS) W70-03649

CONSERVING RESOURCES AND MAINTAIN-ING A QUALITY ENVIRONMENT, Agricultural Research Service, Beltsville, Md. Soil and Water Conservation Research Div. Cecil H. Wadleigh, and Clarence S. Britt.

Journal of Soil and Water Conservation, Vol 24, No 4, p 172-175, Oct 1969. 4 p, 4 ref.

Descriptors: *Water resource development, *Water pollution, *Eutrophication, Government supports, Soil conservation, Industrial wastes, Municipal wastes, Fertilizers, Pesticides, Soil erosion, Animal wastes, Economics, Nitrogen, Water con-Identifiers: *Soil runoff, Livestock.

Some of the problems involved in natural resource conservation are presented, with particular emphasis on the water pollution caused by agricultural runoff and livestock production. It is pointed out that the economics of the farming and livestock industry are often in conflict with the conservationists' interests. It is suggested that the Dept of Agriculture adopt a cost-sharing program to encourage solutions to some of the problems. The article emphasizes the dangers of eutrophication induced by animal wastes. The author concludes with a statement of some of the accomplishments of the conservation movement in the area of soil and water resources. (Murphy-Rutgers)

THERMAL DISCHARGE AND WATER OUALI-TY IN A 1,500-ACRE RESERVOIR,
Missouri Univ., Columbia. Dept. of Zoology; and

Missouri Dept. of Conservation. Fisheries Div. For primary bibliographic entry see Field 05C. W70-03845

NITRATE CONTENT OF THE UPPER RIO GRANDE AS INFLUENCED BY NITROGEN FERTILIZATION OF ADJACENT IRRIGATED LANDS,
Agricultural Research Service, Riverside, Calif.

Salinity Lab. C. A. Bower, and L. V. Wilcox.

Soil Science Society America Proceedings, Vol 33, No 6, p 971-973, Nov-Dec 1969. 3 p, 1 fig, 3 tab, 11 ref.

Descriptors: *Water pollution, *Fertilizers, *Nitrates, Water quality, Soils, Nitrogen, Water pollution sources, Streams, Irrigated land, Irriga-

Identifiers: Upper Rio Grande.

Over a 30-year period the application of nitrogen fertilizer to three irrigated areas adjacent to the Upper Rio Grande increased from a very low to a high level. At the same time, the overall nitratenitrogen concentration of the river did not increase. It is concluded that no significant stream pollution by nitrate-nitrogen has occurred from the nitrogen fertilizer. (Carstea-USGS) W70-03849

USE OF CHEMICAL AND RADIOACTIVE TRACERS AT THE NATIONAL REACTOR TESTING STATION, IDAHO, National Reactor Testing Station, Idaho Falls,

Idaho. For primary bibliographic entry see Field 02F.

ENVIRONMENTAL TRITIUM STUDIES AT THE NATIONAL REACTOR TESTING STA-

Atomic Energy Commission, Idaho Falls, Idaho. D. B. Hawkins, and B. L. Schmalz.

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 157-158, 1967. 2 p.

Descriptors: *Tritium, *Radioisotopes, *Radioactivity techniques, *Tracers, Nuclear reactors, Environmental effects, Water pollution, Lakes, Forecasting, Statistical methods, Idaho.

Identifiers: *Tritium contamination, National Reactor Testing Station, Salt Lake City.

The extent to which the National Reactor Testing Station (NRTS) in southeastern Idaho has contributed to the over-all tritium contamination of the environmental waters is discussed. The total quantity of tritium that fell on this region was similar to the tritium concentration in Salt Lake City, Utah. It was concluded that NRTS operations have not contributed noticeably to the over-all tritium contamination of this region. Tritium was used in calculating the average rate of groundwater movement at the NRTS; the movement averages about 13 ft/day. A log-normal plot of the cumulative percent frequency of tritium versus time was found to be useful in predicting the mean velocity of ground-water. (Carstea-USGS) W70-03898

Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B-Sources of Pollution

THE USE OF A TRACER TEST TO VERIFY AN THE USE OF A TRACER TEST TO VERIFT AN ESTIMATE OF THE GROUNDWATER VELOCITY IN FRACTURED CRYSTALLINE ROCK AT THE SAVANNAH RIVER PLANT NEAR AIKEN, SOUTH CAROLINA,

Geological Survey, Aiken, S.C.

For primary bibliographic entry see Field 02F. W70-03899

USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES: CHAPTER III,

Northeastern Univ., Boston, Mass. Dept. of Civil Engineering.

Alvin Goodman, and Richard J. Tucker.

Identifiers: Sensitivity analysis.

FWPCA, Research Series Report ORD-6, p 19-41, July 1969. 2 fig, 9 tab.

Descriptors: *Mathematical models, *Water quality control, *Sewage treatment, *Optimization, *Decision making, *Biochemical oxygen demand, Dissolved oxygen, Simulation analysis, Computers, Economics, Design.

A steady state mathematical model was applied to a study of a water pollution control program. Input data for the steady state model included hydraulic constants and stream purification rate constants for each reach of the river, population and economic information for each community and assumptions with respect to administrative decisions. For various levels of sewage treatment for each community, a computer program evaluated water quality throughout the length of the stream, and the costs and benefits of the water pollution control program. An optimizing routine determined desirable levels of sewage treatment for each river section in accordance to a specified water quality criteria. A sensitivity analysis by computer simulation was carried out, in which the biochemical oxygen demand and dissolved oxygen parameters were investigated within a possible range. The resulting river water qualities, degrees of treatment, and economic effects, in combination, formed a picture of how different assumptions might affect the ultimate design. (See Vol. 3, No. 9, Field 5C, entry W70-03488). (Thiuri-Cornell) W70-03933

USES OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES: CHAPTER IV,

Northeastern Univ., Boston, Mass. Dept. of Civil Engineering.

Alvin Goodman.

FWPCA, Research Series Report ORD-6, p 42-64, July 1969. 23 p, 5 fig.

Descriptors: *Mathematical model, *Water pollution control, *Biochemical oxygen demand, *Distion control, *Blochemical oxygen demand, *Dis-solved oxygen, *Waste assimilative capacity, Coliforms, Chlorides, Upstream, Time, Unsteady flow, Variability. Identifiers: Unsteady state model.

A time varying mathematical model was developed and used in a water pollution study. The objective of the model was to make maximum use of data obtained from records and field surveys of the Merrimack River, and to produce the results needed to examine the effectiveness of water pollution control programs. Techniques were developed for tracing a time profile of flow and quality in terms of biochemical oxygen demand, dissolved oxygen, coliforms, and chlorides, while the upstream discharge, water temperature, and solar radiation were changing. The time varying model was used to investigate the effectiveness of an assumed configuration of treatment plants when the stream's assimilative capacity varied with distance and time. (See Vol. 3, No. 9, Field 5C, entry W70-03488). (Thiuri-Cornell) W70-03934

CARBON SOURCES IN ALGAL POPULATIONS AND ALGAL COMMUNITY STRUCTURE,

Oklahoma Water Resources Research Inst., Still-

Troy C. Dorris.

Available from the Clearinghouse as PB-189 523, Available from the Clearinghouse as PB-189 523, \$3.00 in paper copy, \$0.65 in microfiche. Research Project Technical Completion Report, Oklahoma WRSIC Institute (1969). 10 p, 1 fig, 2 tab. OWRR Project No B-005-OKLA.

Descriptors: *Carbon, *Algae, *Population, *Biological communities, Effluents, Eutrophication, Phytoplankton, Decomposing organic matter, Oklahoma, Reservoirs, Sampling, Industrial wastes, Municipal wastes, Sewage, Adsorption, Activated carbon, Filters, Seasonal, Stratification, Biochemical oxygen demand, Carbon radioisotopes, Detergents, Antifreeze, Oxidation, Photosynthesis, Oil wastes, Garbage dumps, Pigments, Dams, Physicochemical properties, Chlorophyll.

Identifiers: Arkansas River (Okla), Tulsa (Okla), Pollution, Fossil, Cimarron River (Okla), Bixby (Okla), Keystone Reservoir (Okla), Carotenoids.

A portion of a study to determine source and distribution of organic compounds in the Keystone Reservoir, Oklahoma, and the development of phytoplankton populations in response to eutrophication processes resulting from decomposition of organic compounds in effluents entering the Cimarron arm of the reservoir is described. Or-ganic compounds from industrial and municipal sewage effluents were sampled by adsorption on activated carbon filters at six stations to develop information on seasonal changes in quantity and na-ture of organic compounds, effect of stratification on movement and changes of compounds, and pol-lution of the Arkansas River by effluents from Tulsa. The effort to identify particular compounds, trace their progress through the reservoir and determine extent of their degradation by passage through the reservoir is expected to be completed with further study. Extraction of adsorbed compounds from carbon filters has been accomplished but data were incomplete. Phytoplankton studies on the Cimarron arm of the reservoir were designed to study effects of eutrophication of the water by domestic and industrial effluents. The full spectrum of photosynthetic and other pigments was measured as each sample was taken. Efforts were made in species identification. (Jones-Wisconsin) W70-04001

5C. Effects of Pollution

BIOLOGICAL EFFECTS OF HANFORD HEAT ON COLUMBIA RIVER FISHES - A REVIEW, Battelle Memorial Inst., Richland, Wash. Pacific R. E. Nakatani.

US Atomic Energy Commission, BNWL-SA-1682, 1968. 24 p, 12 fig, 1 tab.

Descriptors: *Heated water, *Temperature, *Nuclear reactors, *Fish behavior, Salmon, Trout, Cooling water, Thermal pollution, Path of pollutants, Fish, Chinook salmon, Thermal powerplants, Columbia River.

Identifiers: Hanford reactor, Priest Rapids Dam.

To obtain information on the effects of heated discharges from the reactors at Hanford, Washington, on fish in the Columbia river, the temperature tolerance of young chinook salmon exposed to 7 different temperatures was investigated; the lowest temperature was similar to the average river temperature at Priest Rapids dam, and it was found that increased temperature resulted in increased body weight. Adult salmon and steelhead trout were fitted with sonic tags so that their behavior in the vicinity of the waste-water plumes could be detected; the results showed no evidence of a tem-perature block, but the fish tended to migrate upstream along the opposite bank from the reactor sites. (Rietveld-Vanderbilt) W70-03721

THE RELATION OF TEMPERATURE TO OXYGEN CONSUMPTION IN THE GOLDFISH,

Toronto Univ. (Ontario). F. E. J. Fry, and J. S. Hart. The Biological Bulletin, Vol 94, No 1, p 66-77, 1948. 6 fig, 2 tab, 17 ref.

Descriptors: *Oxygen requirements, *Temperature, Fish, Metabolism, Fish behavior, Oxygen. Identifiers: *Goldfish, Standard metabolism, Maximum oxygen uptake.

Two levels of oxygen uptake in the goldfish were measured at temperatures from 5 deg C to 35 deg C. The lowest point in the resting metabolism in the daily cycle was taken to be the standard rate and was measured over levels of oxygen high enough to avoid any dependence of the rate on oxygen tension. The maximum steady rate of oxygen uptake found when the fish were stimulated to activity in a rotating chamber was measured over a series of oxyen tensions down to the asphyxial level. The standard rate continued to increase with temperatures up to 35 deg C, while the maximum rate was found by interpolation to reach its highest value at about 30 deg C and to remain steady or decrease slightly at higher temperatures. The maximum rate of oxygen uptake became dependent upon the oxygen tension between 15 and 40 mm Hg, depending tension between 15 and 40 mm Hg, depending upon the temperature. Oxygen tensions at which the maximum oxygen uptake met only the needs of the standard metabolism were estimated to be between 4 and 25 mm Hg over that same range of temperatures. The difference between the maximum and standard metabolic rates was correlated with the rate at which goldfish can swim steadily at the various temperatures, and it was concluded that the drop in the sustained swimming rate of the goldfish at temperatures from 30 deg C to 38 deg C was probably due to a decrease in the metabolism available for external work rather than to the thermal destruction of enzymes. (Speakman-Vanderbilt) W70-03722

THE EFFECT OF DIETARY FAT ON THE HEAT TOLERANCE OF GOLDFISH (CARASSIUS AURATUS),

British Columbia Univ., Vancouver. Dept. of

Zoology.
W. S. Hoar, and J. E. C. Dorchester.
Canadian Journal of Research, Sect D, Zool Sci, Vol 27, p 85-91, 1949. 3 fig, 1 tab, 12 ref.

Descriptors: *Heat resistance, *Diets, Fish, Temperature, Fishkill, Mortality, Fish diets. Identifiers: *Goldfish, Fats, Unsaturation.

Three groups of goldfish were acclimated at 20 deg C and fed diets containing 25% fat. The diets for the three groups differed in the degree of unsaturation of these fats. Pilchard oil, herring oil, and lard were the fats used. Heat tolerance of the fish was then tested by holding them at a constant temperature of 36 deg C and observing the time of death. Variations in the ability of the groups to withstand high temperature were correlated with differences in the degree of unsaturation of their extracted fats. in the degree of unsaturation of their extracted fats. The degree of unsaturation of their extracted fats. The degree of unsaturation of their extracted fats. The degree of unsaturation of the poldfish prior to feeding and no change in the value for fish fed on this diet was observed. Each of the other two diets changed the degree of unsaturation of the goldfish fats by approximately 54% of the maximum theoretical change. These changes modified the heat resistance of the fish. The change in heat resistance resulting from the lard diet was equivalent to a change in acclimation temperature from 20 deg C to 24 deg C. The degree of modification of heat tolerance, however, cannot be strictly correlated with the degree of change of unsaturation of fats and it is concluded that factors associated with differences in melting point rather than melting point of the fat itself are probably involved in heat resistance. When the rates of death of the fish during the first 75 minutes at 36 deg C were compared, no statistical difference between the behavior of the samples fed the fish-oil diets existed, but the sample fed the solid diet (lard) was distinct. (Speakman-Vanderbilt) in the degree of unsaturation of their extracted fats.

W70-03723

GROWTH OF LARGEMOUTH BASS FRY AND VARIOUS TEMPERATURES,

Arkansas Univ., Fayetteville. Dept. of Zoology. Kirk Strawn

Transactions of the American Fisheries Society, Vol 90, No 3, p 334-335, July 1961. 1 fig, 2 ref.

Descriptors: *Temperature, *Growth rates, Fry, Fish eggs, Fish management, Productivity, Fish, Mortality, Fishkill.

Identifiers: *Largemouth bass.

Largemouth bass (Micropterus salmoides) eggs which had begun to hatch were taken from hatchery ponds and placed in aerated jars maintained at 15.0 deg, 17.5 deg, 20.0 deg, 22.5 deg, 25.0 deg, 27.5 deg, and 30.0 deg C. Fry were then removed from the tanks, beginning on the first day they started feeding. Samples of 10 fry from each temperature were preserved in 5 percent formalin.
The growth rate of the fry at each temperature was determined by measuring total length in millimeters. Growth rate increased with increasing temperature, with the maximum occurring at 27.5 deg and 30.0 deg C. The 15.0 deg C fry did not feed and all died of starvation. (Speakman-Vanderbilt) W70-03733

THERMAL DISCHARGE AND WATER QUALI-

TY IN A 1,500-ACRE RESERVOIR,
Missouri Univ., Columbia. Dept. of Zoology; and
Missouri Dept. of Conservation. Fisheries Div. E. R. Brezina, Robert S. Campbell, and James R.

Whitey.

Journal Water Pollution Control Federation, Vol 42, No 1, p 24-32, Jan 1970. 9 p, 2 fig, 4 tab, 26 ref. OWRR Proj No B-001-MO.

Descriptors: *Thermal pollution, *Reservoirs, *Missouri, Thermal powerplants, Stratification, Thermal stratification, Water temperature, Ecology, Aquatic habitats, Turbidity, Dissolved oxygen, Water quality.

Identifiers: Montrose Reservoir (Mo).

This study reports on the effects of thermal discharges from a 525,000-kw fossil-fueled steam-electric plant into a 4.5 billion gal reservoir with a mean depth of 8.2 ft, in central Missouri. The most significant effect observed during the 21-month study was temperature elevation which averaged 5 deg to 8 deg C with a maximum difference in mean temperatures of 10 deg C. Differences in DO were deg to 8 deg C with a maximum difference in mean temperatures of 10 deg C. Differences in DO were always less than 1 mg/l. The area heated by the thermal discharge is influenced by the direction of the prevailing wind. The relatively shallow depth of the reservoir with the wind effects minimizes with thermal stratification and maintains suspension of fine particles. Runoff water maintains the high level of turbidity in the reservoir. There was no significant difference in living matter present in the heated and unheated areas of the reservoir. (K-napp-USGS) W70-03845

RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL DISPERSING

PRODUCTS,
Washington State Water Pollution Control Commission, Olympia. Dept. of Fisheries.
Harry B. Tracy, Ronald A. Lee, Charles E. Woelke, and Gene Sanborn.
Journal Water Pollution Control Federation, Vol 4, No 12, p 2062-2069, Dec 1969. 1 fig, 4 tab, 4 ref.

Descriptors: *Biossay, *Dispersion, *Emulsifiers, *Toxicity, *Oil, Aquatic environment, Estuaries,

Fish, Larvae.
Identifiers: *Pacific Northwest, *Dispersant, *Oil spills, Washington freshwater bioassays, Saltwater bioassays, In-situ bioassays, Group-number.

In a joint effort to provide information concerning oil dispersing products to organizations involved in oil spill control in the Pacific Northwest, the State

of Washington conducted bioassays and evaluation experiments on eleven selected, commercial, U.S. oil dispersants. The test organisms for the toxicity were: steelhead fingerling, Pacific oyster larvae, and coho salmon fingerling dispersing evaluations were made visually. Each dispersant was scored on each test and from these scores, group assignments were made. Dispersant selections were determined from a group-number combination method. Thus, a score of one was given for a comparatively high dispersing property and a relatively low toxicity on the bioassays; a score of four was awarded for the converse of the foregoing factors. That is, dispersants bearing low group-number combinations provided least threat to the aquatic environment and more efficient dispersion. Selection of dispersant depends on size and location of spill. (D'Arezzo-Texas) W70-03913

A METHOD FOR PREDICTING THE EFFECTS

OF LIGHT INTENSITY ON ALGAL GROWTH AND PHOSPHOROUS ASSIMILATION, Abbott Labs., North Chicago, Ill. Dept. of Sanitary Engineering; and Michigan Univ., Ann Arbor.

H. S. Azad, and J. A. Borchardt.

Journal Water Pollution Control Federation, Vol
41, No 11, Part 2, p R392-R404, Nov 1969. 10 fig, 14 ref.

Descriptors: *Algae, *Chlorella, *Scenedesmus, *Light, Phosphorus, Photosynthesis, Light intensity, Stabilization, Ponds, Penetration, Absorption. Identifiers: *Beer-Lambert Law, *Fixed-density studies, *Fixed-light tests, *Effective-average-light-intensity, Photo-electric turbidostat, Light extinction coefficient, Algal cell density.

Research is devoted to obtaining a better understanding of the interaction of light intensity on the rate of algal growth, and phosphorous uptake by algae in an aqueous environment. Green Algae Chlorella and Scenedesmus were grown under a carefully controlled environment. The light intensity was varied by two methods: (1) maintenance of a constant biomass density by using a photo-electricturbidostat apparatus providing for variable light intensity control at the sources; (2) maintenance of the incident luminous energy at a constant value providing for variable algae cell density. The Beer-Lambert expression (I sub 0/I = e to the power CAD) failed to predict the light penetration data. However, an empirical relationship in which the familiar coefficient of extinction was replaced by an exponential variable did provide the necessary agreement. Algal growth rate vs. the culture-face-light intensity yields a curve that implies the ex-istence of a light saturation point. When growth rate vs effective average light intensity was plotted, a more logical effect of light was produced. (D-'Arezzo-Texas) W70-03923

BACTERIAL POPULATION OF HUMIFIED LAKES (IN RUSSIAN), Akademiya Nauk SSSR, Leningrad. Zoologicheskii

For primary bibliographic entry see Field 02H. W70-03948

PHYTOPLANKTON NUTRIENT ENRICHMENT EXPERIMENTS OFF BAJA CALIFORNIA AND IN THE EASTERN EQUATORIAL PACIFIC OCEAN.

Scripps Institution of Oceanography, La Jolla,

William H. Thomas.

Journal Fisheries Research Board of Canada, Vol 26, No 5, p 1133-1145, 1969. 2 fig, 7 tab, 19 ref.

Descriptors: *Phytoplankton, *Inorganic compounds, Nitrogen, Phosphates, Aquatic life, Vitamins, Ocean currents, Nutrient requirements, Nutrients.

Identifiers: EDTA, Carbon-14, Baja California, Eastern Equatorial Pacific Ocean, Oceans, Coastal upwelling, EASTROPAC expeditions.

Results are reported of ten enrichment experiments carried out with natural illumination and prolonged incubation in the eastern equatorial Pacific Ocean. Carbon-14 uptake or changes in chlorophyll were used to assess the effects of enrichment in all experiments. The first five, between June 1964 and November 1966, indicated the most important limiting nutrient in oligotrophic water was nitrogen. Experiments were again carried out during January-March 1967, as the initial part of Expedition EASTROPAC, when areas of nutrient-rich waters were also sampled. These nutrient-rich waters were caused by seasonal upwelling (such as off Baja California), nonseasonal upwelling (the Costa Rica Dome), and of upwelling plus advection from the Peru Current (the nutrient-rich equatorial area). Tests of nutrient-poor waters confirmed that the primary nutrient limiting the population was nitrogen. In nutrient-rich water from equatorial upwelling, limitation by any specific nutrient were not found. Single additions of trace metals and vitamins stimulated chlorophyll synthesis; however, marked changes suggest that the populations in nutrientrich waters were not nutrient limited. (Haskins-Wisconsin) W70-03949

EXCRETION OF DISSOLVED ORGANIC COM-POUNDS BY AQUATIC MACROPHYTES, Michigan State Univ., Hickory Corners. W. K. Kel-logg Biological Station. Robert G. Wetzel.

BioScience, Vol 19, No 6, p 539-540, 1969. 2 tab,

Descriptors: *Aquatic microorganisms, Carbon assimilation, Lakes, Photosynthesis, Organic com-

pounds, Marl, Lakes. Identifiers: *Najas flexilis, Carbon-14, Ionization, Chamber-electrometer, Photosynthetic carbon fixation, Aquatic macrophytes.

Interactions of inorganic parameters on rates of photosynthesis and excretion of total dissolved organic compounds (TDOC) by submerged angiosperm typical of marl lakes were studied. Photosynthetic rates were determined by uptake of carbon-14 labeled bicarbonate as determined by combustion to radiocarbon dioxide-14 and analysis in the gas phase. Mean rates of photosynthetic car-bon fixation by Najas flexilis and rate of percentage of DOC excreted to the mean photosynthetic rate in response to increasing concentration of calcium, magnesium, sodium, and potassium are calculated.
Photosynthetic rates consistently increased with increasing concentrations of calcium ions in the range 0.20 milligram/liter, but exhibited marked decrease at higher concentrations. DOC synthesized demonstrated a progressive reduction in rela-tion to photosynthetic fixation. Photosynthetic rates were markedly reduced by increasing concentration of magnesium ions to and above those normally formed in typical marl lakes. DOC excretion was high in the range of 0-4 milligram/liter magnesium ions and particularly at concentrations above 15 milligram/liter. High rates of DOC loss above 15 milligram/liter. High rates of DOC loss prevailed in absence of sodium ions; rates decreased significantly at low levels of 1-3 milligram/liter, but increased markedly with higher concentrations of sodium ions. This pattern closely paralleled the photosynthetic rates. (Haskins-Wisconsin)

DISTRIBUTION, CHARACTERIZATION, AND NUTRITION OF MARINE MICROORGANISMS FROM THE ALGAE POLYSIPHONIA LANOSA AND ASCOPHYLLUM NODOSUM,

AND ASCOPHYLLUM NODOSUM, McGill Univ., Montreal (Quebec). Dept. of Microbiology and Immunology; and New Brunswick Univ., Fredericton. Dept. of Biology. E. C. S. Chan, and Elizabeth A. McManus. Canadian Journal of Microbiology, Vol 15, No 5, p 409-420, 1969. 5 fig, 4 tab, 38 ref.

Descriptors: *Marine microorganisms, *Algae, *Nutrient requirements, *Distribution, Bacteria, Sampling, Sea water, Seasonal, Pseudomonas,

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C-Effects of Pollution

Temperature, Amino acids, Intertidal areas, Carbohydrates, Yeasts, Enzymes, Cultures, Hydrogen sulfide, Electron microscopy, Biochemistry,

Vitamins, Epiphytology.

Vitamins, Epiphytology.

Identifiers: *Polysiphonia lanosa, *Ascophyllum nodosum, Vibrio, Flavobacter, Escherichia, Sarcina, Staphylococcus, Achromobacter (Alkaligenes), Rhodotorula, Growth factors, Colonial morphology, Cellular morphology, Flagellation, Iodine test, Gram reaction, Cytophaga, Proteus, Serratia, Bay of Fundy (Canada), Rhyzoids.

Bacterial populations of two associated littoral marine algae, Polysiphonia lanosa and Ascophyllum nodosum, and their environmental seawater were studied quantitatively. Samplings showed numbers of bacteria on P lanosa and in the seawater remained relatively constant while those on A nodosum decreased in mid-summer, after an apparent spring maximum, and then gradually increased. Pure cultures of 25 isolates were studied and identified to genus level. There was a prepon-derance of the genera Vibrio and Flavobacter (8 each). Three of the Escherichia group, 2 of Pseudomonas, one each of genera Sarcina, Staphylococcus, and Achromobacter (or Al-kaligenes), and a pink yeast (Rhodotorula) made up the other isolates. Optimum temperature for growth of most isolates was around 21C. Five isolates failed to grow at 30C; 20 did not grow at 37C; of the 5 growing at 37C, development was feeble in every case but one. Studies on gross nutritional requirements of the marine organisms showed that 22 of 25 isolates required a supplement of amino acids in growth medium. Two were able to grow on basal medium; one isolate grew only in a medium supplemented with growth factors in addition to amino acids (Jones-Wisconsin) W70-03952

AVAILABILITY OF MUD PHOSPHATES FOR THE GROWTH OF ALGAE, H. L. Golterman, C. C. Bakels, and J. J. Jakobs-

Mogelin.
Verhandlungen der Internationalen Vereinigung fur theoretische und angewandte Limnologie, Vol 17, p 467-479, 1969. 10 fig, 3 tab, 10 ref, discus-

*Eutrophication, *Mud (Lake), *Aquatic algae, *Bioassay, Phosphates, Water pollution Descriptors: *Phosphorus, Scenedesmus, sources.

Identifiers: *Dutch lakes, *Allochthonous phosphates, Ultra-violet light sterilization, Asterionella, Scenedesmus obliquus, Growth conphosphates, stats, River Rhine.

Avilability of lake muds phosphorus to algae was determined by employing Scenedesmus obliquus as test organism. Culture solutions contained potassium phosphate in different concentrations, calcium phosphates, iron phosphates, and lake muds as the only source of phosphorus. The growth constants were obtained from cultures with inorganic phosphates. Based on the number of cells of Scenedesmus, a considerable fraction of mud phosphorus was available to algae. Depending on the origin of sediment, from 7 to 30.5% of phosphorus was used for cell growth. Sterilization with ultra-violet light had no significant influence on the growth of organisms. Results suggested that Scenedesmus is utilizing largely allochthonous phosphorus for Asterionella algae. (Wilde-Wisconsin) um phosphate in different concentrations, calcium W70-03955

MARINE RADIOECOLOGY

Washington State Univ., Pullman; and Nevada Operations Office (AEC), Las Vegas. Eldon Edmundson, Jr., Vincent Schultz, and Alfred

W. Klement, Jr.

US Atomic Energy Commission, Div of Technical Information, TID-3917, Biology and Medicine (TID-4500), Oct 1969, 127 p.

*Radioecology, Descriptors: *Radioactivity. *Bibliographies, Oceanography, Aquatic environments, Estuaries, Water pollution sources, Water pollution effects, Radioactive waste disposal, Radioactivity effects, Brackish water, Fallout. Identifiers: *Marine studies, Biological oceanography.

raphy, Laboratory studies, Field studies, Anadromous species, Catadromous species, Radioactive contamination, Radioecological concentration.

Interest continues to grow in marine radioecology, a diverse and widely ranging subject, about which literature is relatively extensive and scattered. It is believed that this bibliography of 1450 entries in cludes most major Non-Russian publications, other than progress reports in the field. Dates of publication of documents cited span the period 1908-1969, with approximately 59% dated 1960 or later. The Japanese literature is extensively covered. Additional foreign-language coverage includes Italian, French, German, Finnish, Chinese, and Korean. (Eichhorn-Wisconsin) W70-03956

RELATION BETWEEN FILTERING RATE, TEMPERATURE, AND BODY SIZE IN FOUR SPECIES OF DAPHNIA,

Yale Univ., New Haven, Conn. Osborn Memorial

Limnology and Oceanography, Vol 14, No 5, p 693-700, 1969. 2 fig, 2 tab, 18 ref, discussion.

Descriptors: *Grazing, *Temperature, *Daphnia, Physiological ecology, Lakes, Environmental effects, Water pollution effects, Epilimnion, Connecticut, Euglena, Chlamydomonas, Phosphorus radioisotopes, Regression analysis, Algae, Ponds, Predetice. Predation.

Identifiers: *Filtering rate, *Body size, *Compara-tive studies, Daphnia schodleri, Daphnia pulex, Daphnia galeata mendotae, Daphnia magna, Selenastrum, Rhodotorula, Temperature coefficients, North America, Central America, Rate equations, Analysis of variance, Food concentration, Mexico, Predictive equations, Zoogeography, Thermobiology.

Filtering rates (F) of cladocerans can be measured by determining their uptake of radiophosphorus from labelled food. F of four daphnid species, fed from labelled food. F of four daphnid species, fed on labelled yeast, were measured at temperatures of 15C, 20C, and 25C. Maximum F increased with rising temperature and body size in all species, but a general equation relating F to body length (L) could not be derived. Body weight (W) can be deduced from L with equations of type, log W = log a + b log L, where a and b are empirically derived coefficients. Data are tabulated for a and b of all species considered collectively and individually. species, considered collectively and individually. F, expressed in milliliters water filtered per hour/milligram daphnid dry weight, differed among species. F for adult Daphnia schodleri (DS) and Daphnia pulex (DP) were similar, and at 20C, were slightly higher than at 15C or 25C. F for Daphnia magna (DM) and Daphnia galeata mendotae (DG) increased with increasing temperature. Temperature coefficients (Q-10) for F, changing in range 15-25C were, for four species: DG-2.71, DM-2.38, DP-0.94, DS-0.90. Thermal determinants of maximum. imum F may determine success of daphnids occupying warm epilimnetic lacustrine waters in summer. (Eichhorn-Wisconsin)
W70-03957

UPTAKE OF GLYCINE BY BLUE-GREEN AL-

CAIE, California Univ., Irvine. Dept. of Organismic Biology; and Gujarat Univ., Ahmadabad (India). Botany Div.
G. C. Stephens, B. S. Vaidya, and O. P. Saxena. Indian Journal of Experimental Biology, Vol 7, No 1, p 43-44, 1969. 1 fig, 3 ref.

Descriptors: *Cyanophyta, *Amino acids, Carbon radioisotopes, Radioactivity, Carbon dioxide,

Chlorophyta, Metabolism. Absorption, Chromatography, Identifiers: *Uptake, *Glycine, Oscillatoria jasorvensis, Gloeotrichia pisum, Microcystis aeruginosa, Autoradiography, Assimilation, Spirogyra, Heterotrophy.

Uptake of glycine-carbon-14 was measured in three species of blue-green algae: Oscillatoria jasorvensis, Glocotrichia pisum, and Microcystis aeruginosa. Radioactivity in breis of Oscillatoria increased with increasing incubation time in glycine-carbon-14 solution (100 microns carbon/liter distilled water). Uptake rate increased with the increasing ambient glycine-carbon-14 concentration, maximum velocity of uptake being 0.0000004 moles/gram tissue per hour. Radio-activity lost from the medium is measured quantitatively as radioactive carbon dioxide and as much as 15% of radioactive carbon dioxide and as much as 15% of radioactivity is lost from glycine-carbon-14 at 0.0000009 moles/liter. Most experiments were conducted with Oscillatoria, the easiest organism to use. Results indicate positive absorption and assimilation of glycine by blue-green algae compared to negative results with green alga, Spirogyra. Bluegreen algae investigated are capable of obtaining and utilizing glycine from dilute solution; the glycine obtained can enter oxidative pathways as indicated by carbon dioxide production or may act indicated by carbon dioxide production or may act as a substrate for synthesis. The potential significance of this capacity of heterotrophy depends on the level of free amino acids in the environment.
(Jones-Wisconsin)
W70-03958

CONCEPTS OF EUTROPHICATION AND TROPHIC BIOLOGY, Oesterreichische Akademie der Wissenschaften,

Vienna. Lunz Biological Station.
For primary bibliographic entry see Field 02H.
W70-03959

THE ROLE OF PHOSPHATE-SOLUBLE BACTERIA IN THE ASSIMILATION OF ROCK PHOSPHATE PHOSPHORUS UNDER CONDITIONS OF MONOBACTERIAL CULTURE (IN RUSSIAN),

Moskovskaya Sel'skokhozyaistvennaya Akademiya

l. T. Geller

Izvestiya Akademii Nauk SSSR, Ser Biol, No 1, p 171-175, 1969, 4 tab, 15 ref.

Descriptors: *Bacteria, *Phosphorus, *Phosphates, **Cultures, Soil bacteria, Oats, Corn (Field), Organic acids, Fertilizers, Pseudomonas.
Identifiers: Peas, Sugars, Phosphate-dissolving, Pseudomonas fluorescens, Organic excretions.

Experiments were conducted concerning effect of phosphate-dissolving bacteria and a soil bacteria mixture on availability of phosphorus in minerals to peas and oats. Greenhouse trials with sterilized and inoculated media and test plants whose root systems had different capacity for dissolving phosphates indicated monoculture of Pseudomonas fluorescens exerted a positive influence domonas fluorescens exerted a positive influence on peas and oats growth, increasing utilization of phosphate mineral. Pea plants inoculated with soil suspension grew less than control plants. Total phosphorus content was higher in bacterized cultures. Apparently reduced growth of inoculated plants was caused by bacteria-produced toxic substances disrupting normal plant development. Bacteria influence on solubility of phosphate minerals was determined from composition of organic excretions of roots. Peas and oats, during initial growth stages, excreted equal amounts of organic substances; corn. also investigated, excreted more. substances; corn, also investigated, excreted more. substances; corn, also investigated, excreted more. Root excretions of corn were largely sugars and small amounts of amino-nitrogen. Oats gave the maximum content of amino-nitrogen in dry matter. Pea root excretions contain acidic substances, were free from sugars, and had relatively small amounts of amino-nitrogen. Microorganisms utilized all detected sugars as the only source of carbon in the medium, followed by formation of acids. (Jonea-Wisconsin)

W70-03960

RX FOR AILING LAKES--A LOW PHOSPHATE

International Joint Commission-United States and

For primary bibliographic entry see Field 02H. W70-03964

A DISCUSSION OF NATURAL AND ABNOR-

MAL DIATOM COMMUNITIES, Academy of Natural Sciences, Philadelphia, Pa. Dept. of Limnology. Ruth Patrick.

Algae and Man, Jackson, Daniel F, (editor), Plenum Press, New York, p 185-204, 1964. 6 fig, 2 tab. 46 ref.

Descriptors: *Biological communities, *Diatoms, *Water pollution effects, Streams, Rivers, Environmental effects, Biomass, Bioindicators, Physiological ecology, Temperature, Salinity, Nutrients, Dystrophy, Acidic water, Humic acids, Chrysophyta, Oligotrophy, Eutrophication, Pennsylvania, Estuaries, Maryland, Hydrogen ion concentration, New Lersey, South Carolina Industrial waters. Jersey, South Carolina, Industrial wastes, Texas. Jersey, South Carolina, Industrial wastes, Texas. Identifiers: *Community structure, Species composition, Eunotia, Savannah River, McMichael Creek (Pennsylvania), Middle River (Maryland), Ridley Creek (Pennsylvania), Egg Harbor River (New Jersey), Fragilaria, Achnanthes, Navicula, Nitschia, Synedra, Wateree River (SC), Gomphonema, Melosira, Cymbella, Neches River (Texas), Navicula, Bacillaria, Mesotrophy.

Diatom associations have been used variously as bioindicators of natural water quality conditions or of degree of disturbance due to pollution. Because we know little regarding physiological require-ments and tolerance to pollution of particular spe-cies of diatoms, it is difficult to assess whether variations in species abundance and composition are due to normal environmental variation or to specific effects of pollutants. Changes in community structure, as indicated by changes of numbers of species or changes in percentage of composition of diatom communities attributable to dominant species. cies, may be more reliable criteria of general pollutional conditions in flowing water. These principles are illustrated with data from a variety of streams are illustrated with data from a variety of streams and rivers of differing trophic or pollutional status. It can be shown, for example, that parameters of community structure for a dystrophic stream and for a badly polluted one are similar. In some cases, it is possible to find specific diatoms which are indicators of pollutional conditions duplicating natural conditions occurring during geological time. (See Vol 2, No 19, Field 5C, W69-07832). (Eichhorn-Wisconsin)

THE RESPONSE OF NATURAL MICROBIAL POPULATIONS IN SEAWATER TO ORGANIC ENRICHMENT,

Woods Hole Oceanographic Institution, Mass.

Raiph F. Vaccaro. Limnology and Oceanography, Vol 14, No 5, p 726-735, Sept 1969. 6 fig, 10 ref.

Descriptors: *Water pollution effects, *Eutrophication, *Seawater, *Marine microorganisms, *Organic matter, *Microbial populations, Carbon radioisotopes, Kinetics, Atlantic Ocean, Amino acids, Carbohydrates, Organic acids, Aquatic populations, Massachusetts, Plankton, Estuaries, Microbiology, Physiological ecology.

Identifiers: *Enrichment, *Microbial populations, Heterotrophy, Heterotrophic potential technique, Michaelis-Menten equation, Lineweaver-Burk equation, Sargasso Sea, Glycine, Glucose, Phenylacetic acid, Malic acid, Woods Hole (Mass), Microplankton, Heterogeneous populations, Sodium lactate, Assimilation, Substrate affinity, Turnover times.

The heterotrophic potential technique (HTP) is based on kinetic behavior of enzymes, described by

Michaelis-Menten equation. Aquatic microbial Michaelis-Menten equation. Aquatic interioral populations are incubated for short periods in presence of radiocarbon-labeled substrates (car-bohydrates, amino and organic acids) and radiocarbon uptake determined. If plot of uptake velocity versus substrate concentration yields a hyperbolic curve, this can be converted to linear form (Lineweaver-Burk plot) whose intercept and reciprocal slope estimate, respectively, maximum time for complete removal of substrate, and maximum uptake rate. Applied to marine and other populations, uptake responses often fail to develop or resultant patterns are uninterpretable. When enrichment period is extended to 24 hours or more, such difficulties may be overcome. This shift in behavior provides a desirable source of cells for bioassays, and means for studying dynamics of heterotrophy. Trophic significance of organic matter in seawater might be studied by identifica-tion of specific compounds, but the complexity of this approach suggests that HTP might provide an effective alternative. Regional studies show no single kinetic pattern characterizing uptake by marine microplankton, and that heterotrophs are apparently inactive to some supposedly labile compounds, which phenomena may indicate a need for more rigid definition of 'availability' of organic compounds. (Eichhorn-Wisconsin) W70-03967

BACTERIAL GROWTH RATE IN THE SEA: DIRECT ANALYSIS BY THYMIDINE AUTORADIOGRAPHY,

Indiana Univ., Indianapolis. Dept. of Microbiology.

Thomas D. Brock. Science, Vol 155, No 3758, p 81-83, Jan 1967. 1 tab, 8 ref.

Descriptors: *Bacteria, *Growth rates, *Marine microorganisms, *Analytical techniques, Tritium, Rhodophyta, Connecticut, Rhode Island.

Rhodophyta, Connecticut, Rhode Island. Identifiers: *Autoradiography, *Thymidine, Epiphytes, Leucothrix mucor, Pure cultures, Heterogeneous cultures, Antithamnion sarniense, Iceland, Long Island Sound (Conn), Microbial ecology, Non-parametric statistics, Narragansett Bay (RI), Cape Reykjanes (Iceland), Sudurnes (Iceland), Italy, Bay of Naples, Scotland, Loch Ewe (Scotland).

Estimating cellular growth rates with tritiated thymidine (TT) assumes that: desoxyribonucleic acid (DNA) is synthesized only by dividing cells; TT is incorporated into acid-insoluble cellular fraction only during DNA synthesis; cellular TT incorporation is detectable autoradiographically. TT incorporation rates in Leucothrix mucor, a marine filamentous epiphyte with recognizable morphology, was estimated in pure cultures by incubating with TT in seawater medium and preparing autoradiograms after different incubation periods. Radioactive cells were scored from autoradiograms. Comparison of incorporation rates with generation times yields relationship that 1% cells become radioactive after 0.002 generation. If following assumptions hold, that relationship can be used to estimate generation times in natural populations: relationship between TT uptake and generation time is constant within species; rate of TT uptake is linear and without lag; dilution of TT uptake is linear and without lag; dilution of TT with naturally occurring nonradioactive thymidine is negligible. Generation time (in minutes), so determined, for natural populations of Leucothrix from two sites were: Iceland 685, Long Island Sound 660. In combined pure culture with red alga, Anoou. In combined pure culture with red alga, Antithamnion sarniense, in medium not normally supporting growth of Leucothrix alone, its generation time was 94. Described technique should be adaptable to organisms incorporating TT; available in pure culture; microscopically recognizable in nature. (Eichhorn-Wisconsin)

REPORT OF AN ALGAL BLOOM IN VIET-

Hungarian Univ. of Agricultural Sciences, Godollo (Hungary). Inst. of Botany and Plant Physiology.

T. Hortobagyi.

Acta Biologica Academiae Scientiarum Hungaricae, Vol 20, No 1, p 23-34, 1969. 5 fig, 23 ref.

Descriptors: *Algae, Temperature, Cyanophyta, Chlorophyta, Scenedesmus, Benthos, Convection, Waves (Water), Fish, Sewage, Euglenophyta, Diatoms. Biological communities, Backwater,

Diatoms, Biological Ponds, Alaska. Identifiers: *Bloom, *Vietnam, Little Lake (Hanoi), Red River (Vietnam), Chlorococcus, Spines, Schizomycophyta, Caulobacteriales, Chlorococcales, Conjugatophycaea, Planctomyces, Bacillariophyta, Gloecapsa, Merismopedia, Microcystis, Ankistrodesmus, Pediastrum, Tetraedron, Tetrastrum, Tisza (Hungary), Zimona (Hungary), Algal taxonomy, Spirulina, Chodatella, Miracantha, Buzsak (Hungary), Jamuna (India), Hormogonales, Aphanocapsa, Coelosphaerium, Chloronostoc, Pelodictyon, Synechocystis, Anabaena, Lyngbya, Oscillatoria, Romeria, Astasia, Schroederia, Coelastrum, Dictyosphaerium, Gloeoactinum, Golenkinia, Nephrochlamys, Nephrocytium, Oocystis, Siderocelis, Staurastrum.

An algal bloom of vivid green color developed in Little Lake, Hanoi (water temperature 13-26C). The lake, an isolated backwater of the Red River, contains contaminated water. The bloom was rich in species and new taxons with Cyanophyta and Chlorophyta from both surface and bottom dominating. Scenedesmus variability was dominating. Scenedesmus variability was prominent. A sample indicated 115 species without Bacillariophyceae. The number of Scenedesmus species was larger than in the bloom. Cyanophyta dominated with 82% in the algal bloom and 92% in the bottom sample; Chlorophyta with 12% and 6.8%, respectively. No definite line of demarcation exists between the two biotopes because the algal bloom developed above the bottom and bottom plants are easily raised near the surface by waves, convectional streaming and fish movement. The algae of the two biotopes are different, the phytobiocoenoses being dissimilar. Number of common taxons is 51% of the total; undescribed taxons is 33%. Parallel morphoses are well represented by some Scenedesmus species. Among spiny forms of the Chlorococcales, those of thin spines are less frequent. Protuberances become more developed in Hanoi and toward the tropics. (Jones-Wisconsin) W70-03969

STUDIES ON THE RESISTANCE OF MARINE BOTTOM INVERTEBRATES TO OXYGEN-DEFICIENCY AND HYDROGEN SULFIDE, Kiel Univ. (West Germany). Institut fuer Meereskunde.

H. Theede, A. Ponat, K. Hiroki, and C. Schliefer. Marine Biology, Vol 2, No 4, p 325-337, 1969. 6 fig, 5 tab, 67 ref.

Descriptors: *Invertegrates, *Oxygen requirements, *Gastropods, Temperature, Crustaceans, Oxygen, Hydrogen sulfide, inhibitors, Benthic fauna, Oceans, Metabolism.

Identifiers: Lamellibranchs, Polychaetes, Echinoderms, North Sea, Baltic Sea, Kattegat, Cyprina, Scrobicularia, Mya, Nereis, Asterias, Ophiura, Carcinus, Gammarus, Idotea, Crangon, Mytilus, Cardium, Littorina littorea, Littorina saxatilis.

Resistance to oxygen deficiency and presence of hydrogen sulfide of bottom invertebrates from various biotopes of the North and Baltic Seas was investigated under laboratory conditions. Resistance of animals to adverse conditions was greater in species inhabiting soft bottoms than in those inhabiting hard or sandy substrata. The duration of ciliary movement was longer at lower temperatures. Excised tissues of boreal marine species also extended their activity for a longer period at a low tempera-ture. Isolated gills of Mytilus edulis showed a higher resistance to sulfide ions and hydrogen sulfide at pH 7 than at pH 8. The cellular resistance of euryhaline species to oxygen deficiency and hydrogen sulfide presence declined very slightly with decreasing salinity. (Wilde-Wisconsin) W70-03971

Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects of Pollution

ALGAE, MAN, AND THE ENVIRONMENT.

Proceedings of an International Symposium held at Syracuse University, June 18-30, 1967. Daniel F Jackson, Editor. New York, Syracuse Univ Press, 1968.554 p.

Descriptors: *Algae, *Environmental effects, *Human population, *Eutrophication, *Conferences, Nuisance algae, Publications, Water pollution ef-*Eutrophication, *Conferences, Nuisance algae, Publications, Water pollution effects, New York, Chlorophyta, Nutrients, Ecosystems, Phytoplankton, Photosynthesis, Cyanophyta, Cytological studies, Electron microscopy, Waste treatment, Lakes, Water quality, Viruses, Algicides, Fish, Streams, Productivity, Identifiers: *Phycology, NY State Science and Technology Found, Syracuse (NY), Syracuse University, Fundamental studies, Applied studies, Algal physiology, Algal biochemistry, Algal taxonomy, Algal phylogeny, Cladophora, Algal genetics, Russia, Bavaria, Moriches Bay (NY), Onondaga Lake (NY).

Phycological studies are important not only because of nuisance effects of algae for man, but also for their potential benefits. To compile information on basic and applied phycology, a symposium--which this volume records--was sponsored by New York State Science and Technology Founda-tion and Syracuse University, New York (18-30 June 1967). Volume is organized into three sections: fundamental phycology, applied phycology, and algal studies in New York State. The following and algal studies in New York State. The following topical list of 27 papers by 32 contributors indicates its scope: historical phycology (1927-1967); taxonomy and phylogeny in algal biochemistry and physiology; algal requirements for micronutrients; phosphate metabolism of green algae; nitrogen input to aquatic ecosystems; light and temperature effects on algae; phytoplanktonic photosynthesis; photosynthesis of Cladophora; biology of filamentous conjugating algae; approach to modern algal taxonomy; trends in algal genetics; cytology of cyanophytes (blue-green algae); ultrascytology of cyanophytes; Russian experiments in algal culture; phycological medicine; Russian soil algology; harvesting waste-grown microalgae; wastewater treatment and algal growth; regeneration of Bavarian lakes; nutrient removal, viral diseases in cyanophytes; algicidal effects; algae-fish relationships; stream assimilation (New York); productivity, Moriches Bay (New York); algal environment, Onondaga Lake (New York); review of algal literature (New York State). An index is provided, (See W70-03974). (Eichhorn-Wisconsin) W70-03973

ONONDAGA LAKE, NEW YORK--AN UNUSUAL ALGAL ENVIRONMENT, Syracuse Univ., N. Y. Dept. of Civil Engineering. Daniel F. Jackson.

Algae, Man, and the Environment, Syracuse Univ Press, New York, p 515-524, 1968.

Descriptors: *Algae, *Aquatic environments, *Eutrophication, *Meromixis, *Water pollution effects, Bioindicators, Nuisance algae, New York, Sewage effluents, Sewage treatment, Industrial wastes, Water chemistry, Diatoms, Chlorophyta, Euglenophyta, Cyanophyta, Chrysophyta, Bioassays, Saline water, Chlorella, Chlamydomonas, Euglena.

Eugiena.
Identifiers: *Onondaga Lake (NY), Eunotia,
Amphora, Gomphonema, Pinnularia, Nitzschia,
Navicula, Syracuse (NY), Enteromorpha intestinalis, Cladophora, Cyclotella, Halochlorococcum, Synechococcus, Carteria, Gonium, Ankistrodesmus, Microspora, Pediastrum, Scenedesmus,
Lepocinclis, Anabaena, Anacystis, Gloeotrichia,
Gloeocapsa, Stauroneis.

Fed by saline springs, Lake Onondaga has highest known chloride content (typically 1460 milli-grams/liter) of New York lakes and is probably grams/liter) of New York lakes and is probably meromictic. Its morphometric, geographic and historical features are described, and water quality data are tabulated to include comparisons with other lakes. Although subject to extensive eutrophication since 1863, it fails to bloom with planktonic cyanophytes, but annual blooms of chlorophytes and euglenophytes have occurred during summers since 1962. Lake receives industrial pollutants. Two characteristic areas are observable, based on distribution of attached algae, Cladophora and Enteremorpha; variations in the ionic ratio, sodium/calcium, are thought to control their distribution. Lake supports abundant growth of diatoms, distributed among 28 genera. In a study to evaluate effects on the lake of replacing primary treatment plants with improved secondary treatment, growth of ten strains of chlorophytes, two euglenophytes, eight diatoms, and five cyanophytes cultured in four concentrations of enriched lake water was compared with their growth in nutrient media. Bioassay data are tabulated; summarized, they indicate that lake's water will not support growth of planktonic cyanophytes, and that some component stimulates growth of diatom, Cyclotella, and the chlorophytes: Chlamydomonas, Halochlorococcus, and Chlorella (Milford strain). (See also W70-03973). (Eichhorn-Wisconsin) W70-03974

EUTROPHICATION: CAUSES. CON-SEQUENCES, CORRECTIVES.
National Academy of Sciences, Washington, D.C.

Proceedings of symposium held June 11-15, 1967, Wisconsin Univ, Madison. Gerard A Rohlich, Chairman, Planning Committee for the International Symposium on Eutrophication. NAS Standard Book No 309-01700-9. Printing and Publishing Office, National Academy of Sciences, Washington, DC, 1969. 661 p.

Descriptors: *Eutrophication, *Water pollution sources, *Water pollution effects, *Water pollution control, *Conferences, Streams, Estuaries, Lakes, control, *Conferences, Streams, Estuaries, Lakes, Great Lakes, Physiological ecology, Water chemistry, Geographical regions, Cycling nutrients, Zooplankton, Algae, Aquatic plants, Paleolimnology, Mathematical models, Bacteria, Phytoplankton, Geochemistry, Benthos, Fish, Ecosystems. Identifiers: National Academy of Sciences (USA), University of Wisconsin, Asia, National Research University of Wisconsin, Asia, National Research Council (USA), US Atomic Energy Commission, National Science Foundation, Office of Naval Research, US Department of Interior, Madison (Wis), Europe, Water pollution assessment, Urban drainage, Agricultural drainage, North America, Forest drainage.

In 1965, a planning committee appointed by National Academy of Sciences-National Research Council (NAS-NRC) recommended that '--an international symposium on eutrophication be held in order that the present worldwide state of knowledge and understanding of this phenomenon can be discussed in open forum and recommenda-tions developed for the effective management of problems and for the course of future research.'
That symposium met at University of Wisconsin, That symposium met at University of Wisconsin, Madison, 11-15 June 1967, sponsored by NAS-NRC, Atomic Energy Commission, Department of Interior, National Science Foundation, and Office of Naval Research. Approximately 600 persons from 12 countries attended. This report of proceedings includes an introductory address, Eutrophication, Past and Present', by Yale University Professor G. E. Hutchinson, and four sections of technical presentations as follows (numbers of contributions to each indicated in parentheses): geographical concepts (9); detection and measuregeographical concepts (9); detection and measurement (7); prevention and correction (8); scientific contributions from eutrophication research (8). Two papers, presented at conference, are not published here. The report also includes an introduction, summary, and series of specific recommendations formulated by the organizing committee: 12 relating to education and information and 8 to research. The committee also recommended that NAS-NRC form a permanent committee to implement its recommendations. (See also W70-03976 and W70-03977). (Eichhorn-Wisconsin)

SOME POSSIBLE PHYSIOLOGICAL STRESSES INDUCED BY EUTROPHICATION,

Toronto Univ. (Ontario).

F.E. J. Fry.
Eutrophication: Causes, Consequences, Correctives. Proceedings of a Symposium, National Academy of Sciences, Washington, DC, p531-536, 1969. 4 fig, 13 ref.

Descriptors: *Eutrophication, *Physiological ecology, Water pollution effects, Dissolved oxygen, Fish, Lakes, Hypolimnion, Brook trout, Carbon dioxide, Rainbow trout, Anaerobic conditions, Toxicity, Respiration, Temperature, Environmental effects, Phytoplankton, Metabolism, Bass, Cierco

Identifiers: *Physiological stresses, Phototrophic zone, Carassius carassius, Rasbora daniconius, Oxzone, Carassus carassus, Rasoona daincomus, Oxykinetic responses, Coregonus artedi, Lake Nipissing (Ontario), Ontario, Canada, Osmoregulation, Micropterus salmoides, Algal blooms, Mechanical effects, Salvelinus fontinalis.

Physiological stresses on organisms induced by eutrophication are little understood. Oxygen reduction in eutrophic waters is probably the most pressing stress on fishes. Two types of fluctuations take place: long-term, occurring in hypolimnetic waters and under ice-cover; and short-term, in phototrophic zones due to variations in illumination. Interactions of carbon dioxide, temperature, and ambient oxygen in influencing physiology of a highly aerobic fish are illustrated with data for brook trout. Rainbow trout respond to lowered ambient dissolved oxygen with increased locomotory activity and increased ventilation, responses which may expose fish to futher stresses. Oxykinetic responses of fishes may move them to regions where dother conditions are unfavorable, and increased ventilation tends to increase uptake of toxic substance via gills. Increased irrigation of gills tends also to increase metabolic cost of osmoregulation, which may amount to about 20% of metabolic rate of rainbow trout in hard waters. Under eutrophic conditions, where oxygen concentrations vary widely during a day, fish are probably not as unstressed as the mean concentration may suggest, even though daily minimum is above lethal level. (See also W70-03975). (Eichhorn-Wisconsin) W70-03976

PHYSIOLOGICAL ECOLOGY,
Oregon State Univ., Corvallis. Dept. of Botany.

Harry K. Phinney.
Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 141-145. 1 fig, 5 ref.

Descriptors: *Physiological ecology, *Aquatic environments, Rivers, Environmental effects, Periphyton, Water pollution effects, Oregon, Bioin-Periphyton, Water pollution effects, Oregon, Bioindicators, Light intensity, Eutrophication, Grazing, Algae, Water chemistry, Biomass, Benthos, Salinity, Snails, Sulfates, Nitrates, Phosphates, Potassium, Iron, Bicarbonate, Zinc, Cobalt, Calcium, Magnesium, Currents (Water). Identifiers: Berry Creek (Ore), Oregon State University, Experimental streams, Seasonal effects, Thermal effects, Aphanizomenon flos aquae, Metolius River (Ore), Community structure, Oxytrema, Organic enrichment, Interactions.

Physiological ecology may be defined as the study of physiological responses of organisms to variations in ecological conditions experienced in nature or to those which can be manipulated in the laboratory. Both laboratory and field approaches to ecology suffer from basic philosophical and methodological defects. Physiological ecologists attempt to retain a balanced perspective, and maintain an awareness of these pitfalls in interpreting data and constructing generalizations. Specific studies are cited which illustrate these principles for a variety of aquatic environments (rivers, laboratory

streams, and estuaries) and for a variety of influencing factors (chemical, physical, and biotic).
Because of complexities in elucidating causal factors influencing species abundance, great caution should be exerted in identifying algal species as indicators of pollution. Accumulation of information relative to physiological ecology is slow, laborious, and fraught with difficulties hampering correct in-terpretation. It is unlikely that 'crash' programs designed to characterize the physiological ecology of cultural eutrophication can provide solutions to our present crisis in time to prevent the foreseeable disaster. (See Vol 3, No 7, Field 5C, entry W70-02775). (Eichhorn-Wisconsin) W70-03978

PRODUCTIVITY OF RIVERS,
Montana State Univ., Bozeman. Center for Environmental Studies.

John C. Wright.
Proceedings of the Eutrophication-Biostimulation
Assessment Workshop, June 19-21, 1969, Calford Assessment worksnop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore. Pac Northwest Water Lab, p 186-206. 8 fig, 6 tab, 24 ref.

Descriptors: *Productivity, *Rivers, Carbon dioxide, Photosynthesis, Aquatic plants, Alkalinity, Bicarbonates, Nitrogen cycle, Ammonia, Organic mater, Bacteria, Nutrients, Phosphates, Nitrates, Groundwater, Respiration, Sampling, Wyoming, Thermal water, Chemical analysis, Insects, Productivity, Diurnal, Standing crop, Light intensity, Plant grouth Solar radiation, Chara growth, Solar radiation, Chara.

growth, Solar radiation, Chara.
Identifiers: Firehole River (Wyo), Madison River (Wyo), Gibbon River (Wyo), Trichoptera, Ephemeroptera, Nez Perce Creek (Wyo), Carbon/nitrogen ratio, Diversity indices, Myriophyllum, Glyceria, Ranunculus, Fontinalis, Potamogeton, Nitella, Ruppia, Utricularia, Zan-nichellia, Carex, Hippuris, Scapania, Berula, Eleocharis, Junus, Rorippa, Hygrophypnum, Fis-

Enrichment of rivers by organic pollution with photosynthetically available carbon dioxide may be equally important as fertilization with other nutrients. Based on field studies, the conclusion is that maximal photosythetic rates are attained only in flowing water of high total alkalinity. Percentage of stream bottom covered by vegetation and diversity of communities multiply with total alkalinity increases. Regardless whether free carbon dioxide or bicarbonate were used as a carbon source, the rate of photosynthesis decreased when initial pH values above 8.0 occurred; presumably this si due to limitation of photosynthesis by decreasing concentrations of free carbon dioxide. Evidence is also presented suggesting that various species of aquatic macrophytes differ in their ability to utilize bicar-bonate ion in contrast to free carbon dioxide. Also determined is that, on the average, 20% of photosynthetically-fixed carbon appears in soluble organic form; the nitrogen cycle appears involved, since soluble organic substances become more enriched with nitrogen during photsynthesis and a rise in ammonia concentrations also accurs during the m ammonia concentrations also accurs during the photosynthetic period. Soluble organic compound, released during photosynthesis, may be important as food substrate for bacteria in flowing-water ecosystems. (See Vol 13, No 7, Field 5C, entry W70-02775). (Jones-Wisconsin) W70-03979

C-14 UPTAKE AS A SENSITIVE MEASURE OF THE GROWTH OF ALGAL CULTURES, California Univ., Davis. Dept. of Zoology; and California Univ., Davis. Inst. of Ecology. Charles R. Goldman, Milton G. Tunzi, and Richard

Armstrong.

Proceedings of the Eutrophication-Biostimulation
Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research
Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p
158-170. 6 fig, 1 tab, 11 ref.

Descriptors: *Carbon radioisotopes, *Algae, *Cul-Chloroshutz. Carron radioisotopes, *Algae, *Cultures, Phytoplankton, Carbon, Radioactivity, Chlorella, Sampling, Effluents, Tributaries, Alkalinity, Hydrogen ion concentration, Nutrients, Phosphorus, Nitrogen, Iron, Growth rates, Chlorophyta, Cyanophyta, Chrysophyta, Photosynthesis.

Photosynthesis.

Identifiers: *Growth, *Uptake, Fixation, Cell
count, Optical density, Particulate organic carbon,
Lake Tahoe (Calif), Chlorella pyrenoidosa,
Selenastrum gracile, Carbon assimilation, Bacillariophyceae, Dinophyceae.

Results of comparisons to determine reliability of carbon-14 experiments with other methods employed for measuring growth in cultures are summarized. These include making cell counts, measuring the increase in light extinction as the cells multiply, and determining the biomass of cells produced. Results of a Chlorella experiment produced. vide a valuable evaluation of these methods. The cell count was quite successful; the optical density method was fastest and easiest but was mainly applicable to measuring concentration of dense cultures. The carbon-14 method can easily be used for measuring algal cell growth in both nutrient-rich and nutrient-poor waters. Carbon-14 can detect and nutrient-poor waters. Carbon-14 can detect growth in water with natural phytoplankton when cell count and optical density methods do not give evidence of any change in algal mass; carbon-14 data give a carbon fixation rate, whereas cell count and optical density measurements are static measures of mass. In addition, carbon-14 experiments yield values proportional to the mass of cells in a culture. The combined effect of nitrogen and phosphorus was to stimulate photosynthesis, the proophords was to sumulate photosynthesis, the greatest stimulation resulting from the maximal addition of the two nutrients. (See Vol 3, No 7, Field 5C, entry W70-02775). (Jones-Wisconsin) W70-03983

5D. Waste Treatment Processes

EVAPORATIVE COOLING OF HEATED IR-RIGATION WATER BY SPRINKLER APPLICA-TION, Battelle Memorial Inst., Richland, Wash. Pacific

Northwest Labs.

J. N. Cline, M. A. Wolf, and F. P. Hungate. Water Resources Research, Vol 5, No 2, p 401-406, Apr 1969. 1 fig, 3 tab, 20 ref.

Descriptors: *Heated water, *Sprinkler irrigation, Temperature control, Cooling, Irrigation, Evaporation, Crop production.
Identifiers: *Impact temperature, Relative humidi-

ty, Nozzle pressure, Evaporative cooling.

Heated water was cooled rapidly to impact temperatures that produce optimum growth in plants by applying the water with a standard irrigation sprinkler. Maximum cooling was observed nearest the sprinkler, where the smallest droplets were measured, and temperatures and mean diameters generally increased with distance from the source. Impact temperatures of the water droplets approached but did not reach wet bulb temperatures. Water as hot as 50 deg C was cooled to droplet temperatures of 25 deg C or less when the sprinklers were operated in an associated arid climate and at line pressures greater than 25 psi. A klers were operated in an associated arid climate and at line pressures greater than 25 psi. A theoretical treatment correlated well with one selected set of experimental data and with predicted cooling rates for specified droplets in several typical atmospheric conditions and one untypical condition for an arid climate. Only under the condition of high relative humidity at a given ambient temperature does it appear that cooling might be insufficient to produce usable sprinkler water from 50 deg C supply water for crop production. (Rietveld-Vanderbilt)

TEMPERATURE RELATIONSHIP IN AEROBIC TREATMENT AND DISPOSAL OF PULP AND PAPER WASTES,

National Council for Stream Improvement, Bal-

William L. Carpenter, James G. Vamvakias, and Isaiah Gellman.

Journal Water Pollution Federation, No 40, p 733-740, May 1968. 3 fig, 6 tab, 12 ref.

Descriptors: *Temperature, *Lagoons, *Activated sludge, *Biochemical Oxygen Demand, Industrial wastes, Pulp and Paper Industry, Pulp wastes. Identifiers: *Aerated Lagoons, Temperature coefficients, Deoxygenation rate, Temperature effect.

Tabulated and graphical results are given of studies on the effect of temperature on the performance of aerated lagoons and activated-sludge plants treating waste waters from pulp and paper mills and on the rate of de-oxygenation of such waste waters in streams. It was found that BOD removal in aerated lagoons is adversely affected by temperatures below 20 deg C, but this effect can be minimized by increasing the retention period to 10 days, when increasing the retention period to 10 days, when BOD removals of 79 per cent can be obtained at temperatures as low as 2 deg C. For activated-sludge treatment the optimal temperature was found to be 37 deg C, and there was a progressive deterioration in performance as the temperature was raised to 52 deg C. The de-oxygenation rate constant was the same for both crude and treated vacets waters and appelled 0.2 at 20 deg C. The waste waters, and equalled 0.2 at 20 deg C. The temperature coefficients for de-oxygenation rate and rates of removal of BOD were estimated. (Rietveld-Vanderbilt) W70-03720

COOLING WATER SOURCES FOR POWER GENERATION,

Westinghouse Electric Corp., East Pittsburgh, Pa. L. G. Hauser.

ASCE National Water Resources Meeting, Memphis, Tennessee, Jan 26-30, 1970. 22 p, 9 fig, 7 tab.

Descriptors: *Cooling, *Thermal pollution, *Cool-Descriptors: "Cooling, "Intermal pollution, "Cooling towers, Thermal powerplants, Environmental engineering, Heat balance, Heated water, Optimization, Nuclear powerplants, Electricity, Electric power production, Electric power costs, Electric power demand, Economic prediction, Costs, Economics, Decision making, Project planning.

The forecast of future electricity production in the U.S.A. is projected; and the possibilities of cooling of the future released heat are discussed. The forecast is made up to the year 2000 and shows that residual heat dissipation will be a serious problem for future generating plants. The further main con-clusions are: (1) The cost of alternate heat dissipa-tion methods is not prohibitive and will not deter the growth in demand for electric power. (2) Approximately 70% of new base load generating stations will require supplemental cooling systems by 1980. (3) Cost penalties of supplemental cooling systems can be minimized with sophisticated analytical techniques. Optimization techniques for overall least cost of power production and cooling are illustrated. (Novotny-Vanderbilt)

COMPARISON STUDIES OF WINKLER VS.

OXYGEN SENSOR, Decatur Sanitary District, III. For primary bibliographic entry see Field 05A. W70-03876

MANAGEMENT OF INDUSTRIAL EFFLUENT DISPOSAL IN BRITAIN,

Distillers Co. Ltd., London (England). Dept. of Effluent and By-Products.

C. J. Jackson.

Journal Water Pollution Control Federation, Vol 41, No 12, p 2018-2025, Dec 1969. 8 p, 2 fig.

Descriptors: *Water management (Applied), *Waste disposal, *Industrial wastes, Water conser-vation, Waste treatment, Waste water treatment, Management, Water law.
Identifiers: *Great Britain, Waste disposal manage-

Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D-Waste Treatment Processes

The relationships between governmental agencies and industrial plants in Britain are outlined. Industrial management investigates all aspects of effluent disposal, taking into consideration the economics of internal treatment or discharge to a public wastewater collection system. Pretreatment prior to discharge to the public system is an important consideration of management. Choice of method involves a comprehensive study of treatment processes. Pilot studies should be made on site. Testing services are available through the government on a repayment basis. Consulting arrangements also may be made with private firms. Control agencies sample outfalls and may initiate legal action against industrial plants with notification and submission of duplicate samples to the plant. Committees of the Confederation of British Industry and the Chemical Industries Association advise industrial operations and act as liaisons between industrial operations and act as hatsons between in-dustry and government. The range of treatment and capital costs for pollution abatement facilities is reported. (Knapp-USGS) W70-03877

TUBE CLARIFICATION PROCESS, OPERAT-ING EXPERIENCES, Neptune Microfloc, Inc., Corvallis, Oreg. Gordon L. Culp, Kou-ying Hsiung, and Walter R.

Conley.
J San Eng Div, Amer Soc Civ Eng, Vol 95, No SA5,
Proc Paper 6823, p 829-847, Oct 1969. 11 fig, 2

Descriptors: *Operations, *Sedimentation, *Sediments, *Design, Costs, Waste water, Tertiary treatment, Filtration, Water treatment, Sewage treatment,

ment, Filtration, water treatment, Sewage treat-ment, Construction, Filtration. Identifiers: *Clarification, *Shallow-depth-sedi-mentation, *Tube-clarifier system, Primary treat-ment, Secondary treatment, Raw water treatment, Pilot tests

The use of small diameter tubes as efficient sedimentation devices has been demonstrated successfully on a plant scale. Shallow settling depths provided by longitudinal flows through tubes results in more efficient clarification at shorter detention times and less cost than for conventional clarificatimes and less cost than for conventional clarification metods. Tubes may be essentially horizontal such that tube clarification is followed by a filtration process and settled solids in tubes drained incident to filter backwasher. By steeply inclining the tubes, settled solids do not accumulate in tubes but slide into the plenum beneath the tubes, precluding tube drainage. Modules of steeply inclined tubes have increased the capacity of clarifiers from 2 to 4 times. Steeply-inclined tube process has been applied to raw water clarification primary secondary. plied to raw water clarification, primary, secondary and tertiary sewage treatment in plants up to 45 mgd capacity. The size and cost of new clarifiers can be reduced by including the tube concept in the original design and construction. (D'Arezzo-Tayse) W70-03911

RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL DISPERSING

PRODUCTS,
Washington State Water Pollution Control Commission, Olympia. Dept. of Fisheries.
For primary bibliographic entry see Field 05C.
W70-03913

GRAVITY THICKENERS FOR ACTIVATED

Alexander Potter Associates, New York.
Anton E. Sparr, and Vincent Grippi.
Journal Water Pollution Control Federation, Vol 41, No 11, Part 1, p 1886-1904, Nov 1969. 12 fig, 1 tab. 26 ref.

Descriptors: *Activated sludge, *Coagulation, *Compaction, Sludge, Disinfection, Equipment, Solid wastes, Temerature, Wastewater. Identifiers: *Sludge density index, *Sludge volume index, *Thickening, *Sludge-volume ratio, *Bench-scale study, Coring, pH, pilot-plant study.

This study investigates the use of gravity thickening of excess sludge from complete treatment activated sludge processes. Factors affecting the concentra-tion in separate thickening tanks of activated sludge alone, or combined with primary sedimentation solids, are discussed. A bench-scale study and historical review are sources of basic data for the investigation. Major subdivisions of the study include: tank geometry, types of thickener, mechani-cal equipment, influent baffling, skimmers, mechanical compactors, sludge pumps, solids con-centration, temperature, loading, pH, coagulation, disinfectants and weighting agents. Mechanical deflectors and rake arms are suggested for more efficient thickening. (D'Arezzo-Texas) W70-03914

TEMPERATURE EFFECTS ON ENERGY OXYGEN REQUIREMENTS IN BIOLOGICAL OX-IDATION,

Weston (Roy F.), Inc., West Chester, Pa. C. S. Shih, and V. T. Stack, Jr. Journal Water Pollution Control Federation, Vol 41, No 11, p R461-R474, Nov 1969. 7 fig, 9 tab, 17

Descriptors: *Oxidation, *Oxygen demand, *Synthesis, *Temperature, Activated sludge, Respiration, Dissolved oxygen, Aerobic conditions,

Degradation.

Identifiers: *Energy oxygen, *Dehydrogenase, *Enzyme activity, Organic substrates, Warburg study, Energy oxygen coefficient, Glucose, Sodium acetate, Ethylene glycol, Potassium hydrogen phthalate, DO Uptake, Short term oxygen demand,

Temperature effects on energy oxygen requirements are considered a key quantitative parameter in the aerobic biological oxidation phase of waste treatment. Energy oxygen is the net consumption of oxygen in support of synthesis reactions. The energy oxygen coefficient is the total energy oxygen consumption less endogenous oxygen divided by organic substrate material. Biological oxidation studies were made for various organic substrates at different temperature conditions. Two different evaluation methods were used: (1) graphical in-tegration of dissolved oxygen uptake versus time; (2) short term oxygen demand. The coefficient va-ries with the substrates oxidized and temperature. The role of dehyrogenase activity analysis in biological oxidation is also examined. (D'Arezzo-Texas) W70-03919

FERMENTATION LIOUOR FOR OF SPENT SULFITE THE PRODUCTION OF LIQUOR FOR VOLATILE ACIDS,

Crown Zellerbach Corp., Camas, Wash. Microbiological Research.

H. R. Amberg, T. R. Aspitarte, and J. F. Cormack. Journal Water Pollution Control Federation, Vol 41, No 11, Part 2, p R419-R430, Nov 1969. 4 fig, 9 tab, 18 ref.

Descriptors: *Fermentation, *Volatility, *Acids, *Solvent extractions, Distillation, Productivity.
Identifiers: *Acetic acid, *Calcium base liquors,
*Microbacterial action, Spent sulfite, Liquors,
Volatile acids, Microbial flora, Othmer azeotropic,
Distillation process, Suida process, Brewster

Study and experiments were made to determine if volatile acids, specifically acetic acid, could be produced by fermentation of sugars in spent sulfite liquor. Substrates used for experiments were: (1) steam-stripped digester strength calcium base spent sulfite liquor; (2) residual alcohol-fermented spent sulfite liquor; (2) rementations were made superstanting. sulfite liquor. Fermentations were made successfully on a continuous-flow basis using mixed bacruly on a continuous-flow basis using mixed bacterial culture. Specific major determinations were:

(1) Optimum volatile acid yields were obtained amounting to 155 Kg per metric ton at volumetric waste retention periods of 20 to 30 hours, (2) optimum fermentation temperature was 37 deg C and optimum pH range was 7.0 to 7.5; (3) solids con-

tent of the raw feed liquor had a decided effect of yield; (4) optimum yield was obtained at 9 to 11 percent total solids; (5) the most economical method of acetic acid recovery is solvent extraction followed by azeotropic distillation for solvent recovery. (D'Arezzo-Texas)
W70-03921

BREAKTHROUGH IN THE TRACER STU-DIES OF SEDIMENTATION TANKS,

Nova Scotia Technical Coll., Halifax. Dept. of Civil Engineering. D. Thirumurthi.

J Water Pollution Control Federation, Vol 41, No 11, Part 2, p R405-R418, Nov 1969. 9 fig, 5 tab, 22

Descriptors: *Tracers, *Dispersion, *Sedimenta-tion, *Costs, *Design, Baffles, Inlets, Outlets, Diatomaceous earth, Diffusivity, Dye releases, Fluorometry, Suspension, Settling basins, Reynolds

Identifiers: *Pulse input technique, *Plug flow, *Detention time, *Flow-through curve, Tracer studies, Index of short-curcuiting, Critical settling depth, Peclet number, Morril index, Dispersion index, Continuous-flow systems, Settling index.

Increasing costs of waste treatment compel designoriented research with view toward reducing treatment costs. Sedimentation is considered a vital phase justifying closer analysis. Tracer studies and sedimentation tests were conducted on two consedimentation tests were conducted on two con-tinuous-flow laboratory model settling tanks of similar geometry except length-width ratios. Tracer studies of pulse input technique were made to demonstrate that two selected parameters were reproducible and useful as design criteria for sedimentation systems. The study is unique in the fact that results of tracer tests have been inter-related with results of sedimentation tests on the continu-ous-flow models. The deviation of real systems from the ideality has been considered. A design formula for actual sedimentation tanks has been suggested. Further studies or simulations are needed to validate the suggested design formula. A method is developed to evaluate the relative advantages of geometric design features of sedimentation tanks.
(D'Arezzo-Texas)
W70-03922

A METHOD FOR PREDICTING THE EFFECTS OF LIGHT INTENSITY ON ALGAL GROWTH AND PHOSPHOROUS ASSIMILATION, Abbott Labs., North Chicago, ill. Dept. of Sanitary Engineering; and Michigan Univ., Ann Arbor. For primary bibliographic entry see Field 05C. W70-03923

DIPLOGASTERID AND RHABDITID NE-MATODES IN A WASTEWATER TREATMENT PLANT,

Louisiana Polytechnic Inst., Ruston. Dept. of Zoology; and Southfield School, Shreveport, La. J. L. Murad, and G. T. Bazer. Journal Water Pollution Control Federation, Vol 42, No 1, p 106-114, Jan 1970. 4 fig, 4 tab, 11 ref.

Descriptors: *Aerobic treatment, *Wastewater, *Trickling filters, *Effluents, Wastewater treatment, Settling basins.
Identifiers: *Nematode, *Secondary clarifiers, *Primary clarifier, *Diplogasterid, *Rhabditid, Christie-Perry technique, Ruston (La).

Nematode population samples from various, likely Nematode population samples from various, likely breeding sites in aerobic waste treatment process at wastewater treatment plant, Ruston, Louisiana were analyzed for 15 weeks. The main breeding site, and the main source of the nematodes found in the final effluent was the trickling filter. Secondary clarifiers and final settling tanks effectively removed the nematodes. Nematode removal was highest in the dilution stream under high flow conditions than during normal stream flow. Solids in ditions than during normal stream flow. Solids in the effluent were more efficient in removing nematodes in suspension. Settling without the addition of stream bottom solids provided a 17.1% removal whereas the addition of solids caused a 32.2% removal. (D'Arezzo-Texas) W70-03925

BIODEGRADABILITY AND TREATABILITY OF COMBINED NYLON AND MUNICIPAL WASTES.

Rhode Island Univ., Kingston. Dept. of Civil En-

Gineering.
C. P. C. Poon.

Journal Water Pollution Control Federation, Vol. 42, No. 1, p. 100-105, Jan. 1970. 1 fig., 8 tab., 2 ref.

Descriptors: *Biodegradation, *Industrial wastes, *Treatment, *Wastewater treatment, *Waste disposal, Degradation, Biochemical oxygen demand, Chemical oxygen demand, Aeration, Ac-

mand, Chemical Oxygen demand, Actalon, it itvated sludge. Identifiers: *Nylon, *Nylon waste, *Municipal wastes, pH, Warburg respirometer, Belding Chemi-cal Co. (Conn), Thomaston (Conn).

Nylon waste contains high organic content, large amount of solvents and low pH. The solvents can be recovered economically; therefore, it is advisable to separate the nylon production process waste from the others for recovery purposes. The other wastes can be combined and treated successfully with municipal wastewater. The amount of nylon wastewater which can be accepted by the municipal plant can be determined by specified laboratory studies. It was shown that nylon waste from the Belding Chemical Co. could combine suc-Thomaston Plant at a rate of 1:7 for successful treatment after pH neutralization. Laboratory study involved Warburg respirometer and batch feed aerator. The average chemical oxygen demand removal was 88% at a loading of 0.85 lb COD/day/lb of MLVSS. (D'Arezzo-Texas) W70-03926

PHYSICOCHEMICAL TREATMENT

MASTEWATER,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering; and FMC Corp., Princeton, N.J.
W. J. Weber, C. B. Hopkins, and R. Bloom, Jr. Journal Water Pollution Control Federation, Vol 42, p 83-99, Jan 1970. 10 fig, 1 tab, 14 ref.

Descriptors: *Water reuse, *Waste treatment, *Activated carbon, *Adsorption, *Biochemical oxygen demand, *Sewage treatment, Costs, Nitrates, Phosphates, Tertiary treatment.

Identifiers: *Advanced waste treatment, *Chemical removal, *Physicochemical treatment, Secondary treatment, Total organic carbon, Ewing-Lawrence Sewerage Authority (ELSA), Trenton

Conventional 'secondary' biological waste treat-ment processes are inadequate to provide the effluent quality needed for water reuse purposes or to provide a satisfactory degree of pollution protection to receiving natural water bodies, based on anticipated, more stringent future demands. A process using chemical clarification, filtration, and adsorption by activated carbon for treatment of primary wastes was designed and tested on a pilotscale basis. This physicochemical treatment process is a major departure from the costlier practice of tertiary treatment methods following conventional secondary treatment. The system was designed for essentially automatic operations. The designed for essentially automatic operations. The physicochemical pilot model phase was operated continuously for 4 months. Consistent total organic carbon and biochemical oxygen demand removals of 95-97%, phosphate removals of 90% and nitrate removals of 95% were obtained. Costs are about \$0.16/1,000 gal, including capital amortization. Process affords flexibilities to expand on a modular basis and to intensify degree of treatment. (D-'Arezzo-Texas) W70-03927 ANIONIC AND NONIONIC SURFACTANT SORPTION AND DEGRADATION BY ALGAE CULTURES.

Texas Univ., Austin. Dept. Environmental Health

Engineering.
Ernst M. Davis, and Earnest F. Gloyna.
Journal of the American Oil Chemists' Society, Vol
46, No 11, p 604-608, Nov 1969. 2 fig, 3 tab, 9 ref.

Descriptors: *Surfactants, *Sorption, *Algae, Chlorophyta, Cyanophyta, Detergents, Spectrosco-

py. Identifiers: *Linear alkyl sulfonates, *Axenic cultures, *Alkyl polyethoxylate, *Alkyl phenol polyethoxylate, Organic extractions, Infrared spectroscopy, Blue-green algae, Green algae.

Investigation was made to determine effects of axenic cultures of 5 species of Cyanophyta algae and 3 species of Chlorophyta algae, which are common to waste stabilization ponds, on ionic and anionic surfactants contained in the bulk of household detergent products. Tests made to determine the sorption characteristics of the surfactants by the algae showed releases and degradation of up to 99% of some of the component parts of the surfactant molecule. Comparative tests using a heterogeneous microcosm associated with laboratory acclimated stabilization pond water showed capability of greater reduction of all surfactant components than the individual algae species. The tests confirmed the feasibility of using infrared spectrophotometric analysis techniques and the adequacy of organic solvents for extraction of surfactants prior to complexation in concentrations of and below 50 mg/l. (D'Arezzo-Texas)
W70-03928

DIALYSIS SEPARATION OF SEWAGE SLUDGE

Nebraska Univ., Lincoln. Dept. of Civil Engineer-

M. J. Hammer, and J. A. Borchardt. J Sanit Eng Div, Proc Amer Soc Civ Eng, Vol 95, No SA5, Paper 6845, p 907-928, Oct 1969. 17 fig, 9 tab, 5 ref.

Descriptors: *Dialysis, *Fermentation, *Sewage sludge, Sewage treatment, Digestion, Digestion tank, Microbiology, Microorganisms. Identifiers: *Anaerobic, *Acidification, *Gasification, *Dialysis fermentation tank, Diffusion, pH, Electrode potential, Membrane, Vinyl plastic, Alkalinity, Volatile acid, Digestion gases, Hydrolysis methane.

The acidification and gasification stages of high-rate anaerobic digestion are studied separately, rate anaerobic digestion are studied separately, using a dialysis-fermentation tank apparatus unique to sanitary engineering research. Raw sludge fed into the tank provided substrate for bacterial production of volatile acids. The acids were then diffused through the plastic membrane in the dialy-sis unit, into the methane fermentation tank for conversion to gaseous end products. The process of sludge digestion can be performed using a dialysis-fermentation tank system. This system permits pseudo-enrichment culturing of the anaerobic sludge digestion stages (acidification and gasification) to take place in separate fermentation tanks. The acidification stage is the rate-limiting process. The acid fermenters operate at sub-optimum conditions to permit optimum conditions needed for methane fermentation of the volatile acids. (D-'Arezzo-Texas) W70-03929

PHOSPHATE REMOVAL AT BALTIMORE,

PHOSPHATE REMOVAL AT BALTIMORE, MARYLAND,
Robert S. Kerr Water Research Center, Ada, Okla.
M. R. Scalf, F. M. Pfeffer, L. D. Lively, J. L.
Witherow, and C. P. Priesing,
J Sanit Eng Div, Proc Amer Soc Civ Eng, Vol 95,
No SA5, Paper 6817, p 817-827, Oct 1969. 6 fig, 1 tab, 4 ref.

Descriptors: *Activated sludge, *Aeration, *Phosphates, Phosphorous, Sewage treatment, Municipal wastes.

Identifiers: *Pilot investigation, *Plant investigation, *Activated sludge treatment, Dye tracer, Biochemical oxygen demand, Mixed liquor suspended solids, Baltimore (Md), San Antonio

Pilot and plant investigations were conducted at Baltimore to determine if high orthophosphate removal process experienced at San antonio, Texas was applicable and feasible in Baltimore, differing in climate, population served and population characteristics. Phosphate removal by activated sludge at Baltimore was a function of mixed liquor dissolved oxygen concentration, BOD loading, and soluble phosphorous loading. Plant research showed in excess of 90% soluble phosphorous removal coinciding with plug flow conditions in the aeration tanks and high dissolved oxygen concen-trations in the mixed liquor and final clarifiers. Pilot studies using aerated containers of mixed liquor containing plant return sludge and primary effluent predicted the reaction of the plant activated sludge process. A minimum mixed liquor suspended solids concentration of 1200 mg/l is needed for over 99% phosphate removal at Baltimora Union with discovering the plant of the plant activated liquor suspended solids concentration. timore. Using mixed liquor suspended solids concentration similar to plant conditions showed: (1) Increased orthophosphate load needed longer aeration for phosphate removal; (2) Increased BOD tion for phosphate removal; (2) increased BOD caused greater initial phosphate concentrations; (3) Increased aeration rates decreased the phosphate removal time. The investigation showed that phosphate removal by the activated sludge process is not unique to the San Antonio, Texas area. (D'Arezzo-Texas) W70-03930

TRICKLING FILTER MODEL: DESIGN AND COST FACTORS, Robert A. Taft Water Research Center, Cincinnati,

Joseph F. Roesler, and Robert Smith. Industrial Water Engineering, Vol 6, No 9, p 46-49, Sept 1969. 8 fig, 6 ref.

Descriptors: *Trickling filters, *Mathematical models, *Design, *Cost allocation, *Biochemical oxygen demand, Waste water treatment, Efficiencies, Capital costs, Operation and maintenance,

A mathematical model of a trickling filter final settling process was described in the study. The model tling process was described in the study. I he model constituted a single subroutine in a computer program involving the preliminary design of wastewater treatment systems. The subroutine specifically computed the relationship of the various physical properties of the trickling filter, BOD removal efficiencies, and costs. The latter included capital, operating and maintenance costs for the trickling filter, final settler and return pumps. The trickling filter, final settler and return pumps. The costs to remove BOD was plotted against the hydraulic loading. For filter depths of 6 and 20 feet, minimum costs were observed near hydraulic loadings of 10 and 20 mgd per acre, respectively. Plots of total costs rather than costs per BOD removed indicated that the greater the specific area, the lower the costs. (Thiuri-Cornell) W70-03947

RECLAIMED WASTEWATER FOR SANTEE RECREATIONAL LAKES, Public Health Service, San Diego, Calif. Santee

John C. Merrell, Jr., and Alberg Katko.

Journal of the Water Pollution Control Federation,
Vol 38, No 8, p 1310-1318, 1966. 2 fig, 7 tab, 3 ref.

Descriptors: *Recreation, *Recreation facilities, *Water quality, Safety, Boating, Fishing, Water utilization, Oxidation lagoons, Activated sludge, Coliforms, Waste water treatment, Water reuse. Identifiers: *Fecal coliforms, *Fecal streptococi blooms, Santee Recreational Lakes (Calif), California, Water reclamation.

The Santee Project in San Diego County, California, has evolved into a reasonably well-balanced

Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

ecological system utilizing wastewater of the community as the productive source of a central aquatic environment that is socially accepted as recreational lakes. Following conventional activated sludge sewage treatment and a 30-day nominal storage in an oxidation pond, the effluent is pumped to a natural shallow aquifer in the valley above the lakes and later recovered as rising groundwater flow for use in three adjacent recreational lakes. Sand filtration increased removals of organics and nutrients to the 98-99% range. A nutrient balance, a comparison of chemical constituents, bacterial concentrations, and virus findings between the secondary effluent and the lakes is presented. The ecological development of these lakes is summarized; diverse algal population, occasional algal blooms, and fish kills are described. Different facets of the biological life, including phytoplankton, zooplankton, aquatic insects, benthic organisms and fisheries are presented (Haskins-Wisconsin) W70-03950

REMOVAL OF SEWAGE NUTRIENTS BY ELECTROLYTIC TREATMENT.

Oslo Univ. (Norway). Inst. of Marine Biology. Ernst Foyn.

Verhandlungen der Internationalen Vereinigung fur theoretische und angewandte Limnologie, Vol 15, p 569-579, Feb 1964. 6 fig, 5 tab, 5 ref.

Descriptors: *Sewage, *Sludge, *Sewage effluents, *Sewage treatment, Phosphates, Sludge disposal, Electrolysis, Biochemical oxygen demand, Eutrophication, Pilot plants, Ammonia, Nitrogen, Hydrogen ion concentration, Sea water.

Identifiers: Turbidity, Elkem electrolytic process, Reagent recovery, Oslo, Magnesium ions, Oslof-jord (Norway), Norway.

The Elkem electrolytic sewage purification process removes raw sewage from sludge, suspended particles, and bacteria, and reduces the content of phosphates to 1.0-1.5 milligram/liter of the ef-fluent. The fraction of removed phosphates depends on the amount of applied electricity, and 200 ampere-hours per cubic meter were found to be most efficacious. The purified effluent was active in reducing the biochemical oxygen demand in unwas reduced 60% by filtration through open sieves. (Wilde-Wisconsin) W70-03972

5E. Ultimate Disposal of Wastes

WASTEWATER RATES AND SERVICE CHARGES IN GREAT BRITAIN,
West Hertfordshire Main Drainage Authority, Rickmansworth (England).
For primary bibliographic entry see Field 06E.
W70-03875

MANAGEMENT OF INDUSTRIAL EFFLUENT DISPOSAL IN BRITAIN,

Distillers Co. Ltd., London (England). Dept. of Effluent and By-Products. For primary bibliographic entry see Field 05D. W70-03877

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: SUM-MARY REPORT,

MAKY REPORT,
Bechtel Corp., San Francisco, Calif.
E. J. Wasp, T. L. Thompson, P. E. Snoek, J. P.
Kenny, and J. C. Carney.
Available from the Clearinghouse as PB-189 756,
\$3.00 in paper copy, \$0.65 in microfiche. Federal
Water Pollution Control Administration Research
Saries Penest DAST 16, Page 1060, 21, e1266. Series Report DAST-16, Dec 1969. 31 p, 13 fig. FWPCA Contract 14-12-156. FWPCA Program 14010 EMS.

*Transportation, Descriptors: *Pipelines, *Waste disposal, Sewage sludge, Land disposal, Continental shelf, Environmental effects, Cost benefit analysis, Institutional constraints, Great Lakes region, Atlantic coastal plain. Identifiers: Northeast Ohio, Baltimore-Washington, Maintenance dredgings, Fly ash, Water treat-

ment, Plant residues.

This is the summary report of a three volume study principally concerned with the development of re-gional land and ocean pipeline disposal systems for digested sewage sludge and maintenance dredgings. In Volume I two study cases are presented, namely, a land disposal system for Northeast Ohio (Cleveland-Canton) and an ocean disposal system for the Baltimore-Washington region. A systems approach is used, in which collection, transportation, and disposal aspects are examined in light of technical, economic and social requirements. Various transport modes are compared, including pipeline, ocean tankers, railroads, and trucks. To a lesser extent, the study also considers the expansion of such systems to include fly ash and water treatment plant sludge. In Volume II present methods and costs of disposal for all four wastes are reviewed. Environmental criteria are presented for examining both land and ocean sludge disposal alternatives in terms of general solution for two broad metropolitan regions, namely, the Great Lakes region from Buffalo to Milwaukee and the Atlantic Coast region from Boston to Norfolk. Results of a loop test program utilizing 12 in and 16 in pipe for pumping digested sludge, fly ash, and sludge-fly ash slurries are included in Volume III as well as corresponding rheological tests with a 1/2 in small tube viscometer and a rotation. tional lab viscometer. A procedure for predicting head losses is given, as well as a review of the state of the art of pipelining of waste materials. (See also W70-04005 thru W70-04007) W70-04004

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: VOLUME I - THE WASTE MANAGEMENT CONCEPT.

Bechtel Corp., San Francisco, Calif.

Available from the Clearinghouse as PB-189 757, \$3.00 in paper copy, \$0.65 in microfiche. Federal Water Pollution Control Administration Research Series Report DAST-16, Vol 1, Sept 1969. IX, 156 p, 33 fig, 31 tab, 14 ref, 4 append. FWPCA Contract No 14-12-156 Project No 14010 EMS.

Descriptors: *Waste disposal, *Sludge disposal, Municipal wastes, Landfills, Systems analysis, Costbenefit analysis, Sanitary engineering, Waste dumps, Agriculture, Dredging, Land management, Pipelines, Fertilizers, Sewage sludge, Fly ash. Identifiers: Sludge transport, Solid waste disposal.

Development of a specific waste management system which collects, transports and disposes of sewage sludge and maintenance dredgings in a sosewage sludge and maintenance dredgings in a so-cially, technically, and economically satisfactory fashion was studied by systems analysis. The feasi-bility of constructing and operating a demonstra-tion project was examined. A major effort in this area is the demonstration project by the Metropolitan Sanitary District of Greater Chicago using sewage sludge for agriculture. For each detailed study case, a disposal system is proposed which effectively serves regional needs, is economi-cally sound, and includes the collection, transpor-tation and disposal of the estimated production of wastes up to the year 2000. The economics of the systems are presented and recommendations are systems are presented and recommendations are made as how to achieve both immediate and longterm objectives. For an immediate solution to the term objectives. For an immediate solution to the national problem of waste disposal of digested sewage sludge, a land disposal system is recommended. A long-term, successful history of beneficially using sludge on land is available. The cost benefit ratio of the sludge disposal system is very favorable. A demonstration project is recommended to prove the viability of the concept. Pipeline transportation is economically better than the other modes evaluated. (See also W70-04004). (Knapp-USGS) W70-04005

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: VOLUME II - CRITERIA FOR WASTE MANAGEMENT, Bechtel Corp., San Francisco, Calif.

Available from the Clearinghouse as PB-189 758, \$3.00 in paper copy, \$0.65 in microfiche. Federal Water Pollution Control Administration Research Series Report DAST-16, Vol 2, Sept 1969. 144 p, 10 fig, 16 tab, 184 ref, append. FWPCA Contract No 14-12-156 Project No 14010 EMS.

Descriptors: *Waste disposal, *Sludge disposal, Municipal wastes, Landfills, Cost-benefit analysis, Municipal wastes, Landmins, Cost-benefit analysis, Sanitary engineering, Waste dumps, Agriculture, Dredging, Fertilizers, Land management, Pipelines, Sewage sludge, Fly ash.
Identifiers: Sludge transport, Solid waste disposal.

Basic environmental criteria were studied for disposal of selected waste materials, including sewage treatment pland sludge, maintenance dredgings, power plant fly ash, and filter plant residues. Both land and ocean disposal alternatives were examined in terms of a general solution for 2 broad regions, namely the Great Lakes Megalopolis from Milwaukee to Buffalo and the Atlantic Coast Megalopolis from Boston to Norfolk. Present methods and costs of disposal have been included to complete the picture of the overall waste disposal problem. (See also W70-0440). (Knapp-USGS)

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: VOLUME III - TECHNICAL ASPECTS OF PIPELINING OF WASTE MATERIALS,

Bechtel Corp., San Francisco, Calif.

Available from the Clearinghouse as PB-189 759, \$3.00 in paper copy, \$0.65 in microfiche. Federal Water Pollution Control Administration Research Series Report DAST-16, Vol 3, Sept 1969. 167 p, 80 fig. 15 tab, 64 ref, 3 append. FWPCA Contract No 14-12-156 Project No 14010 EMS.

Descriptors: *Sludge disposal, *Hydraulic transportation, *Pipelines, *Hydraulics, *Slurries, Waste disposal, Closed conduit flow, Pipe flow, Turbulent flow, Suspension, Mixing, Fly ash, Sewage sludge, Municipal wastes, Sanitary ensisted in the control of the c

Identifiers: Sludge transport, Solid waste disposal.

The feasibility of using pipelines to transport waste materials, and to develop a reliable procedure for the design of such pipelines was studied. A series of laboratory and pipeline tests was performed. Digested sewage sludge and fly ash were chosen as representative materials for the tests. Both materials for the tests. als, sludge because of its fibrous nature and fly ash because the particles are very fine, were transported in homogenous flow in the turbulent regime. Samples taken from the top and the middle of the pipe test sections confirmed this. These materials, individually and in various combinations, were tested at various velocities in 1/2-inch, 12-inch, and 16-inch pipe test sections, for a number of solids concentrations. Digested sludge, fly ash, and fly ash/sludge mixtures can be successfully transported by pipelines. (See W70-04004). (Knapp-USGS) W70-04007

CLASS TWO COUNTIES - SEWER DISTRICTS. For primary bibliographic entry see Field 06E. W70-04024

Water Quality Control—Group 5G

5F. Water Treatment and **Quality Alteration**

PUBLIC HEALTH (MUNICIPAL WATER SUPPLY).

For primary bibliographic entry see Field 03D. W70-04036

5G. Water Quality Control

COMMUNITIES OF OVER 1,000 POPULATION WITH WATER CONTAINING IN EXCESS OF 1,000 PPM OF TOTAL DISSOLVED SOLIDS, Black and Veatch, Kansas City, Mo.

For primary bibliographic entry see Field 07C. W70-03664

BEHAVIOR OF BUOYANT JET IN CALM FLUID.

Hydraulics Research Station, Wallingford (En-

gland). For primary bibliographic entry see Field 08B. W70-03724

PRIVATE SEWER SYSTEMS.

Ohio Rev Code Ann secs 6112.01 thru 6112.05. 6112.99 (Page Supp 1970).

Descriptors: *Ohio, *Sewage disposal, *Water pollution control, *Eminent domain, Sewage, Legislation, Wastes, Sanitary engineering, Waste disposal, Sewage districts, Sewers, Waste water disposal, Pollution abatement, Condemnation, Local governments, Administrative agencies, Planning

Any person may apply to the Department of Health for approval of plans for the construction of a sewage disposal system to serve any geographical area not served by another system. The application must include data establishing the need for the system, as well as surveys and maps necessary to determine the boundaries of the area to be served. The local board of county commissioners certifies that the area is not served by another system. After receiving notice from the Public Utilities Commission that an authorizing certificate has been issued, the Department may act on the application. Construction of the facilities must be supervised by a registered engineer. Any board of county commissioners may purchase or appropriate any system constructed under these sections within its county. The appropriation procedure is the same as the one provided for use by municipal corporations. Maximum penalty for violating these sections is five hundred dollars. (Douberley-Florida) W70-03736

SEWER DISTRICTS.

Ohio Rev Code Ann sec 6117.01 (Page, 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Sewage districts, *Sewers, *Waste disposal, Legislation, Sewage, Sanitary enwaste disposal, Legislation, Sewage, Sanitary en-gineering, Sewage disposal, Sewage treatment, Waste water disposal, Outlets, Ditches, Channels, Public health, Regulation, Planning, Project planning, Administrative agencies.

Boards of county commissioners may establish and maintain sewer districts within their counties and outside of municipal corporations. The boards may acquire, construct, maintain and operate sewers, ditches or channels within their district and any other works within and without such districts as are necessary to carry water to a proper outlet for treatment or disposal. Any board may employ a sanitary engineer and establish a sanitary engineering department. The boards may enact rules and regulations concerning: (1) sewer systems outside municipal corporations; (2) sewer systems inside municipal corporations when they are operated by the board; or (3) municipal corporations' sewer systems which discharge into facilities operated by the board. No sewers or treatment plants may be constructed outside municipal corporations without approval of the plans by the board and su-pervision of the construction by the county sanitary engineer. (Douberley-Florida) W70-03737

SEWERS AND WATERWORKS.

Tenn Code Ann secs 6-1401 thru 6-1439 (1956), as amended, (Supp 1969).

Descriptors: *Tennessee, *Sewers, *Water works, **Cities, Legislation, Legal aspects, Eminent domain, Construction, Maintenance, Damages, Public health, Wastes, Water supply, Sewage disposal, Pumping plants, Treatment facilities, Storage, Water purification, Costs, Administrative agencies, Contracts, Financing, Land tenure, Waste disposal, Sewage treatment, Operation and maintenance, Supervisory control (Power). Identifiers: *Water systems, Bonds.

All cities are authorized to condemn property and All cities are authorized to condemn property and property rights for the purpose of constructing, laying, repairing or extending sewers, water systems or drainage ditches. In order to protect the public health and assure the payment of sewer bonds, cities may require occupants of land abutting sewer systems to connect to such systems and be charged for the use thereof. Two cities may contract for one to use the sewer and water system of the other, or for the joint construction and use of such a system. Every city is authorized to own and operate a waterworks system and a sewerage system. A waterworks system includes supply sources, pumping facilities, purification works, storage facilities and a distribution system. A sewerage system includes a collecting system, intercepting and outfall sewers, pumping stations and treatment, purification and disposal plants. Every city acquiring a waterworks or sewerage system is required to establish a board to have supervision and control of construction and operation of such works. The board will advise the city regarding the necessity of the financing and acquisition of land for new works. The financing of works is provided for by rate collection, bond issuance and other means. (Keith-Florida) W70-03748

POWERS UNDER CITY MANAGER CHARTER. For primary bibliographic entry see Field 06E.
W70-03749

SEWER DISTRICTS: ST. LOUIS COUNTY.

Mo Ann Stat secs 249.010 thru 249.420 (1959).

Descriptors: *Missouri, *Sewage districts, *Sanitary engineering, *Taxes, Construction, Maintenance, Sewerage, Public health, Sewers, Assessments, Judicial decisions, Human population, ments, Judicial decisions, Fluman population, Boundaries (Property), Drainage, Surveys, Maps, Costs, Administrative agencies, Compensation, In-terest, Debt, Financing, Contracts, Laterals, Sewage disposal, Legislation, Pollution.

The circuit court may establish a sewer district for the construction and maintenance of a sewer system in St. Louis County upon petition of, and approval by, the residents of the proposed district. After the filing of such petition, the judge shall apoint a sanitary engineer to establish boundaries, make surveys and maps, and prepare a plan for sewer construction in the proposed district. A general election shall be held to approve taxes to be levied, indebtedness to be incurred, and selection levied, indebtedness to be incurred, and selection of the district trustees. If approved, the trustees may issue bonds and assess taxes to pay expenses of the district. The boundaries of this district may be extended. Qualifications for trustees, the method of their selection, and administrative procedure to be followed are provided. The trustees may: (1) employ an engineer to develop sewer plans; (2) construct and maintain all necessary sewer structures and systems; (3) make necessary contracts; (4) acquire property by condemnation or otherwise; (5) construct sewerage disposal plants; (6) employ and compensate necessary personnel; (7) establish subdistricts with lateral sewer systems; and (8) col-(Dearing-Florida)
W70-03767

SANITARY DRAINAGE DISTRICTS-CITIES OVER 300,000 INHABITANTS AND ADJOINING COUNTIES.

Mo Ann Stat secs 248.010 thru 248.200 (1959).

Descriptors: *Missouri, *Drainage districts, *Sanitary engineering, *Sewers, Construction, Maintenance, Drainage systems, Channels, Administrative agencies, Judicial decisions, Civil engineering, Drains, Surveys, Maps, Expenses, Compensation, Outlets, Taxes, Assessments, Legislation, Legal Easements, Condemnation, Contracts.

Identifiers: *Sanitary districts.

A sanitary district may be established and incorporated by the circuit court whenever the construction and maintenance of a channel or system of drains or sewers is needed for the drainage of any area. Three commissioners appointed by the court shall supervise the district. They shall formulate plans for the drainage system, and if approved by the voters in the district, the court shall order the district to be established. Districts may include more than one county. Selection procedures for a board of trustees of the district are provided. The board may divide the districts into independent subdistricts. The district may acquire rights-of-way or easements by requesting condemnation or easements by requesting condemnators.

The board of trustees may let contracts for all proposed works. A special tax may be levied on lands within the district and bonds may be issued to pay district expenses. Sewers and special drains may be constructed and funded from special taxes on the areas benefited. The district shall be dissolved when the necessary drainage is completed. (Dearing-Florida) W70-03768

LIQUIDATOR FOR SEWER DISTRICTS IN CERTAIN COUNTIES.

Mo Ann Stat secs 249.670 thru 249.700 (1959).

Descriptors: *Missouri, *Sewage districts, *Administration, *Decision making, Judicial decisions, Administrative agencies, Taxes, Costs, Government finance, Payment, Debt, Compensation, Legislation.

Whenever any sewer districts with a population greater than seven hundred thousand but less than seven hundred and fifty thousand is dissolved, the seven hundred and fifty thousand is dissolved, the Governor shall appoint a liquidator of such sewer district. The liquidator shall have all powers and duties of the board of supervisors of the district subject to approval by the circuit court. The officers and supervisors of the district shall cease to have any further power or duties. The liquidator shall have the power to dispose of all property and effects of the district contest any action against the effects of the district, contest any action against the district, and compromise any taxes or indebtedness of the district. (Dearing-Florida)

HEALTH AND SAFETY (PUBLIC WATER SUPPLY AND SEWER SYSTEM).
Tenn Code Ann secs 53-2001 thru 53-2016 (1966), secs 53-2017 thru 53-2022 (Supp 1969).

Descriptors: *Tennessee, *Water works, *Water supply, *Public utilities, Water distribution (Applied), Water utilization, Sewage, Pumping plants, Sanitary engineering, Sewage disposal, Sewage d

field 05-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

tricts, Sewage treatment, Environmental sanitation, Septic tanks, Drains, Engineering structures, Legislation, State governments, Regulation, Per-mits, Public health, Operation and maintenance.

The Department of Public Health controls and supervises construction and operation of public water supplies and sewerage systems. All cross-connections and interconnections between primary and auxiliary water supplies must be approved by the Department. The Department may order cor-rective action to be taken by the operator of any water supply or sewerage system that constitutes a health menace. Procedures are outlined for judicial review of Department orders. The Department is empowered to exercise general supervision over the construction and operation of individual sewage disposal systems for proposed housing subdivisions where public sewage systems are not available. This authority does not exist within city limits. Local health officers are directed to carry out the provisions of this act. Criminal penalties are prescribed for violation of the act. State grants can be made to municipalities for the construction of sewage treatment works. The Department may enter into contracts with municipalities for the construction of proposed water projects. A sewage treatment works account is established to fund authorized activities of the Department. (Barnett-Florida) W70-03780

SOME EFFECTS OF SHADE COVER ON STREAM TEMPERATURE IN SOUTHEAST

Forest Service (USDA), Juneau, Alaska. Pacific Northwest Forest and Range Experiment Station.
William R. Meehan.

USDA Forest Serv Res Note PNW-113, 1970. 9 p, 1 fig, 4 tab, 6 ref.

Descriptors: *Water temperature, *Vegetation effects, *Aquatic environment, Microclimatology, Alaska, Riparian plants, Watershed management,

Cutting management.
Identifiers: Streamside vegetation, Shade effects.

Water temperature differences measured with a precision resistance thermometer over 20-yard intervals show that on clear summer days, shade-producing streamside vegetation is important in cooling or maintaining coolness of small streams. The average temperature increase in unshaded reaches of streams in the Haines-Juneau area was 0.071 deg C. and in the Petersburg-Wrangell area it was 0.164 deg C. In shaded reaches the average temperature decrease was 0.060 deg C. and 0.081 deg C., respectively. Under overcast skies, the effects of shade were very small and the trend was for a slight temperature increase over 20-yard stream reaches-0.011 deg C. and 0.009 deg C., in the two areas. The reasons for the significantly different temperature responses in the two geographic areas are not yet known. (Helmers-Forest Service) W70-03819

EXAMINATION INTO THE EFFECTIVENESS OF THE CONSTRUCTION GRANT PROGRAM FOR ABATING, CONTROLLING AND PREVENTING WATER POLLUTION.

Report to Congress, Nov 3, 1969. 164 p, 7 fig, 12 append.

Descriptors: *Systems analysis, *Water quality control, *Pollution abateness, *Planning, *Mathematical models, Decision making, Alternative costs, Waste water treatment, Water utilization scheduling.

Identifiers: Alternative schedules.

The study examined the effectiveness of the construction grant program administered by the Federal Water Pollution Control Administration for abating, controlling and preventing water pollu-tion in the United States. The development and use of a systems analysis method, and its practicability in an actual waterway was discussed. A mathematical model was developed by Camp, Dresser and McKee and used to evaluate data on the Merrimack River for estimating the construction costs of water treatment facilities for various degrees of water quality. It was concluded that through the use of the systems analysis approach to planning and implementing water pollution programs (a) a least-cost construction plan to achieve water quality standards could be made, (b) more costly but perhaps desirable alternative schedules could be developed and (c) decision makers would be provided with more meaningful data as to enable them to achieve established objectives and the costs of providing various levels of water uses. (Thiuri-Cor-W70-03936

SIMULATION MODEL FOR FLOW AUGMEN-

TATION COSTS, Florida Univ., Gainesville; and Massachusetts Inst.

of Tech., Cambridge. Armando I. Perez, John C. Schaake, and Edwin E.

J Hydraul Div, Proceedings of ASCE, Vol 96, No HY1, p 131-142, Jan 1970. 1 fig, 6 ref, 2 append.

Descriptors: *Simulation analysis, *Sewage treatment, *Flow augmentation, *Optimization, *Regression analysis, Storage capacity, Costs, Reservoirs, Water quality, Streamflow, Computers.

A generalized mathematical model was developed ermit the simulation of the economic and physical interactions of sewage treatment and low flow augmentation, and subsequent evaluation from a water quality standpoint. An essential phase of the project, a study of low flow augmentation storage costs was analyzed. The main objective was to ob-tain optimum functional relationships between the storage volume required and those variables that were found to affect it. The results could then be integrated with regional cost curves to give generalized cost expressions. Initially, monthly streamflow and demand records were generated from historical data by a computer program. The operation of various reservoir sizes was simulated and the number of deficiencies during the time period considered were counted. After this process was repeated for several combinations of values of the variables, the desired regression, or the 'best fit', equation was derived which related storage volume required to these parameters. (Thiuri-Cornell) W70-03940

ECONOMIC ANALYSIS IN WATER QUALITY MANAGEMENT, Washington Univ., Seattle.

For primary bibliographic entry see Field 06B. W70-04000

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: VOLUME I - THE WASTE MANAGEMENT CONCEPT.

Bechtel Corp., San Francisco, Calif. For primary bibliographic entry see Field 05E. W70-04005

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: VOLUME II - CRITERIA FOR WASTE MANAGEMENT,

Bechtel Corp., San Francisco, Calif. For primary bibliographic entry see Field 05E. W70-04006

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: VOLUME III - TECHNICAL ASPECTS OF PIPELINING OF WASTE MATERIALS, Bechtel Corp., San Francisco, Calif. For primary bibliographic entry see Field 05E. W70-04007

SEWERAGE - WATER WORKS.

Mo Ann Stat secs 250,010 thru 250,250 (1959).

Descriptors: *Missouri, *Public health, *Sewage districts, *Water pollution control, Water works, Legislation, Legal aspects, Cities, Construction, Maintenance, Treatment facilities, Waste disposal, Sewers, Water purification, Liquid wastes, Solid wastes, Industrial wastes, Domestic wastes, Administrative agencies, Costs, Assessments, Taxes, Financing, Rates, Planning, Leases, Pollution abatement, Water supply, Water quality. Identifiers: *Bonds, *Sewer districts, Improvements ments.

Cities and sewer districts are authorized to acquire, construct, improve, extend, maintain and operate sewerage systems for the protection of the public health. 'Sewerage system' means storm water systems, sanitary systems, sewerage systems, sewerage treatment plants and collection, purification and disposal facilities. Two or more cities are authorized to operate combined waterworks and sewerage systems. Cities may delegate to their boards of public works the responsibility for and control of combined systems. The cost to any city or sewer district of acquiring, constructing, improv ing or extending a sewerage system or combined system will be financed through tax levies, assessments, general revenue funds or bond issuances. Cities and sewer districts are authorized to charge reasonable rates for the use of their sewerage systems. Cities may charge industrial establishments for the operation by the city of sewerage facilities to abate or reduce industrial water pollution. It is the purpose of this chapter to enable cities and sewer districts to protect the public health and welfare by preventing or abating water pollution and by supplying wholesome water. Cities and sewer districts are empowered to do all things necessary to carry out these purposes. (Keith-Florida) W70-04025

THE FUTURE OF THE NORTH CAROLINA COASTAL AREA.

National Estuarine Pollution Study, The Future of the North Carolina Coastal Area, p 1-12 (1969).

Descriptors: *North Carolina, *Estuaries, *Water pollution, *Administration, Management, Water policy, Water resources development, Water zoning, Regulation, State governments, Aquatic habitats, Estuarine fisheries, Estuarine environment, Oceanography, Local governments, Federal government, Fish management, Project planning, Recreation, Impaired water quality, Pollutants, Legal aspects.

The responsibility for regulation of North Carolina's estuaries should rest with state and local governments. The federal government should progovernments. The tederal government should provide guidance, advice, and services only where the problems are beyond the capability of the state. Some commentators would prefer federal control of estuaries. Planned zoning should be used to prevent pollution resulting from indiscriminate development and filling in estuarial areas. A comprehensive system of land and water management should be implemented. Burgeoning industry in estuarine areas should be regulated to prevent polestuarine areas should be regulated to prevent polestuarine. estuarine areas should be regulated to prevent pol-lution, but unduly restrictive water quality stan-dards might damage the state's economy. Pollution of estuaries injures the fish population. Recrea-tional uses of waterways require clean water. Uniformity of laws controlling waste from pleasure craft is necessary. Tourism is a large factor in the economy of North Carolina. Research in environ-mental ecology is best conducted by universities. Studies should be made of: (1) the biological con-tributions of estuaries to continental shelf waters, (2) the environmental effects of pesticides, (3) the assimilation capacities of the sounds, (4) the assimilation capacities of the sounds, (4) the biological effects of industrial and domestic wastes, and (5) a comparison of the water levels in estua-ries and the sea. (Dye-Florida) W70-04032

Techniques of Planning—Group 6A

GENERAL SEWER SYSTEM. Mo Ann Stat sec 88.801 (Supp 1970).

Descriptors: *Missouri, *Sewage disposal, *Mu-Descriptors: Missouri, Schage disposar, micipal wastes, *Taxes, Assessments, Government finance, Sewage districts, Sewage treatment, Sewers, Environmental sanitation, Wastes, Waste water disposal, State governments, Legislation, Cities, Regulation.

All cities in this state containing more than ten thousand and less than thirty thousand inhabitants and possessing special charters are empowered to establish general sewer systems. There are four classes of sewer systems: public, district, joint dis-trict, and private. Public sewers shall be established along principal courses of drainage at such time, to such extent, of such dimensions and under such regulations as provided by municipal ordinance.
The city may levy a 'special public sewer tax' over all taxable property within the city. (Dye-Florida) W70-04033

PRIVATE SEWERS.

Mo Ann Stat secs 88.813 thru 88.817 (1952).

Descriptors: *Missouri, *Sewage disposal, *Municipal wastes, *Sewage districts, Assessments, Government finance, Sewage treatment, Sewers, Environmental sanitation, Wastes, Waste water disposal, State governments, Legislation, Legal aspects, Regulation, Cities, Condemnation.

Private sewers may be connected to public or district sewers and regulated by city ordinance. The city shall not assume the costs of construction, repair, or cleaning of private sewers. Expenses in-curred for maintenance of district and joint district curred for maintenance of district and joint district sewers are paid out of the general appropriation for that purpose. The city may condemn property necessary for the construction of any sewer. Where a sewer is laid on uncondemned property, the city may be compelled by mandamus or other appropriate action to exercise its right of condemnation (Dye. Florida) tion. (Dye-Florida) W70-04034

PRIVATE SEWERS. Mo Ann Stat sec 64.300 (1966).

Descriptors: *Missouri, *Sewers, *Sewage, *Odor, Domestic wastes, Legislation, Sewage disposal, Sewage effluents, Ditches, Recreation, Recreation facilities, Condemnation, Closed conduits, Disposal, Open channels, Remedies, Regulation, Legal aspects.
Identifiers: Penalties (Criminal).

All sewers and ditches used for carrying raw sewage or effluent from land located near recreation areas in certain counties are required to be fully enclosed. If any such sewer or ditch emits of-fensive and unhealthy odors, it shall be considered a nuisance and condemned as such. The condemned sewers and ditches may not be used for carrying raw sewage and effluent until all causes of the odors are completely eliminated. Any person found guilty of using any open ditch or sewer after it has been condemned shall be guilty of maintaining a nuisance. A maximum penalty of \$1,000 and one year's imprisonment is provided. (Schram-Florida)
W70-04040

06. WATER RESOURCES **PLANNING**

6A. Techniques of Planning

DETERMINATION OF OPTIMAL FLOOD PRO-TECTION LEVELS WITH SMALL EX-CEEDANCE PROBABILITIES, Carnegie-Mellon Univ., Pittsburgh, Pa. Richard M. Shane, and Donald P. Gaver.

Water Resources Research, Vol 5, No 6, p 1223-1228, Dec 1969. 6 p, 1 fig, 2 tab, 4 ref, append. NSF Grants GP-8824 and GK-1482.

Descriptors: *Probability, *Flooding, *Frequency analysis, *Statistical methods, Regression analysis, Markov processes, Forecasting, Economics, Costbenefit analysis, Statistical models, Correlation Identifiers: *Flood frequencies.

A technique for selecting flood protection levels that exceed mean flood intensities by a large amount is based on a probability model derived from the assumption that base flow floods occur at random with exponentially distributed magnitudes. It is a parametric approach involving the estimation of two statistical parameters by the method of maximum likelihood. The sensitivity of the results to errors made in choosing the correct flood intensity distribution is examined by computing the loss when the flood intensities are log normally distributed. This loss is shown to be small over a wide range of parameter values likely to be encountered. Through the use of a quadratic loss function it is shown that the expected loss is inversely proportional to the length of record. Furthermore if the existing level of protection exceeds the mean peak flood intensity by a large amount, then parameter estimation losses can be quite large, even when a record of considerable length is available. The quadratic loss function also demonstrates that the loss is due primarily to errors in estimating the expected flood intensity. (Knapp-USGS)
W70-03653

USE OF THE CRITICAL PERIOD IN RESER-

VOIR ANALYSIS,
California Univ., Los Angeles.
For primary bibliographic entry see Field 04A.
W70-03655

DEVELOPMENT **MATHEMATICAL** MODEL AND COMPUTER PROGRAM FOR OP-TIMIZATION OF VERTICAL TUBE EVAPORA-TOR SALINE WATER PLANTS,

Houston Research Inst., Inc., Tex. For primary bibliographic entry see Field 03A. W70-03665

POINT RAINFALL FREQUENCIES IN CON-VECTIVE STORMS,

Arizona Univ., Tucson. For primary bibliographic entry see Field 02B. W70-03673

AN EXAMINATION OF LINEAR HOMOGENEI-TY OF TRADE AND PRODUCTION FUNC-TIONS IN COUNTY LEONTIEF MATRICES,

Pennsylvania State Univ., University Park.
Wesley H. Long.
Journal of Regional Science, Vol 9, No 1, p 47-67,
Apr 1969. 21 p, 1 fig, 11 tab, 10 ref.

Descriptors: *Leontief models, Regional analysis, Homogeneity, Forecasting, Regression analysis, Input-output analysis, Economics.

Identifiers: *Linear homogeneity, *Trade, *Production function, *Leontief matrices, *Leon-tief's assumptions, Leontief functions, Leontief coefficients, Regional economics, Bias, Impact

Leontief's simplifying assumptions about the nature of production functions have allowed the power of linear algebra to be applied to the empirical solution of various models concerning interdependence among producers in an economy. In reciprol geography the Laonting assumptions have pendence among producers in an economy. In re-gional economics the Leontief assumptions have been applied to trade functions, where matrices describe trade relations among industries in a re-gion, as well as to production functions, where matrices describe technological relations among in-dustries. In either case the inverse of the coefficient matrix is used to make forecasts and impact

analyses. These projections are predicated on the linearity and homogeneity of the production or trade function. The purpose of this paper is to examine these two simplifying assumptions by means of a regression analysis of cross-section data for a limited number of expenditures made by various sectors of a county economy. Tests of these assumptions have been made before and the justification for the present investigation is that it approaches the question differently and that it is concerned with a small region. Input-output analysis has been used fairly extensively in the water area. Recently studies have used this method to study water resources in the Western States and this study may provide the basis for an input-output water study for small geographic areas. (Loeb-Rutgers) W70-03824

A GENERALIZATION OF THE CES PRODUC-TION FUNCTION

Oklahoma State Univ., Stillwater; and Iowa State Univ., Ames.

Yao-chi Lu, and Lehman B. Fletcher. The Review of Economics and Statistics, Vol 50, No 4, p 449-452, Nov 1968, 4 p, 7 ref.

Descriptors: *Return to scale.

Identifiers: *CES production function, *VES production function, Elasticity of substitution, Marginal rate of substitution, Cobb-Douglas func-

The main weakness of the CES (constant elasticity of substitution) production function seems to be the empirical starting point. The derivation of the CES function is based on the assumption that the partial regression coefficient of log K/L is equal to zero. The authors feel that the above assumption is not realistic. This position is supported by their empirical findings. The purposes of this paper are: (1) to derive a more general form of the production function that does not depend upon the above assumption and which has the property of a variable elasticity of substitution, (2) to examine the elasticity of substitution of the new function, and (3) to present some evidence of the desirability of using the new function. Production functions can be applied to water supply analysis and the CES and VES (variable elasticity of substitution) functions may prove to be useful specifications of water production and supply functions. (Loeb-Rutgers) W70-03829

LOCATIONAL EQUILIBRIA,

Michigan Univ., Ann Arbor. Edward E. Leamer. Journal of Regional Science, Vol 8, No 2, 229-242, Winter 1968. 14 p, 14 fig, 6 ref.

Descriptors: Demand, Supply, Costs.
Identifiers: *Locational equilibria, Transportation cost function, Objective function, Demand densities, Trade, Market areas, Cournot model.

A fixed demand distributed throughout a plane may be met by the establishment of supply points or sources at various locations. Innumerable situations of this type occur and examples are immediate: airports, warehouses, post offices, etc.
This paper presents source location optima for two families of demand densities. In addition, the author develops a simple mathematical formula relating the transport cost to the number of optimally located sources. Extensions and applications of the formula are discussed. The author shows that economic borders which fracture an otherwise uniformly continuous demand do not cause enough distortion in the optimal allocation of sources to induce significant increases in transport costs. As such, this article might be helpful in locating water reservoirs with respect to actual or projected demand densities and conditions. (Loeb-Rutgers) W70-03839

Field 06-WATER RESOURCES PLANNING

Group 6A-Techniques of Planning

AN EXTENSION OF THE GENERALIZED WERER PROBLEM.

Washington Univ., St Louis, Mo.

Leon Cooper.

Journal of Regional Science, Vol 8, No 2, p 181-197, Winter 1968. 17 p, 1 fig, 2 tab, 7 ref, 1 append.

Descriptors: Costs, Distance, Digital computers. Identifiers: *Generalized Weber problem, Transport distance, Iteration, Local minima, Location studies.

Several papers have independently presented methods for solving the generalization of the Weber problem, i.e., finding a single point (origin or source) in two-dimensional Euclidean space which is the minimum transport distance and/or cost point for any number of destination points. A mathematical statement of the generalization of the simple Weber problem is given. In this paper the author is concerned with a modification of the problem to find the point (x,y) such that the sum of distances or costs proportioned to distances are a minimum. The modification concerns the fact that in realistic situations the cost of shipment or servicing may not be simply proportional to distance (with weights). In some situations it would be more appropriate to assume that the costs were proportional to distance raised to some power. This greater flexibility in realistically and accurately fitting cost data. Such an analysis might be applicable in the water area particularly in situations of designing efficient water pipe line services. (Loeb-Rutgers) W70-03840

TRENT BASIN STOCHASTICS,

Manchester Univ. (England). Dept. of Engineer-

For primary bibliographic entry see Field 02E. W70-03902

GENERALIZED DROUGHT SEQUENCE PROBABILITIES FOR STORAGE-DRAFT-FREQUENCY ANALYSIS, University of the Witwatersrand, Johannesburg

(South Africa). Dept. of Hydraulic Engineering. For primary bibliographic entry see Field 02E.

EFFECTS OF INCONSISTENCY AND NON-HOMOGENEITY ON HYDROLOGIC TIME SE-

Colorado State Univ., Fort Collins, Dept. of Civil

Engineering. For primary bibliographic entry see Field 02A.

THE BAYES REPORTED HYDROLOGY (FRENCH),
HYDROLOGY (FRENCH),
La France, Chatou. Centre de THE BAYES METHODS OF STATISTICAL

Electricite de France, Recherches et d'Essais.

For primary bibliographic entry see Field 02A. W70-03906

EFFECTS OF SAMPLING INTERVAL. PERIODICITY, DEPENDENCE AND SKEWNESS ON EXTREME VALUES, Colorado State Univ., Fort Collins. Dept. of Civil

Engineering.
For primary bibliographic entry see Field 02E.
W70-03910

EXAMINATION INTO THE EFFECTIVENESS OF THE CONSTRUCTION GRANT PROGRAM FOR ABATING, CONTROLLING PREVENTING WATER POLLUTION. For primary bibliographic entry see Field 05G. W70-03936

RESERVOIR SYSTEM DESIGN OPTIMIZA-

Esso Research and Engineering Co., Florham Park, N.J. Environmental Control. For primary bibliographic entry see Field 04A. w 70-03941

OF ECONOMIC SURVEYS RESOURCE ALLOCATION, VOLUME III. For primary bibliographic entry see Field 06B. W70-03990

OPERATIONS RESEARCH,

Harvard Univ., Cambridge, Mass.

Robert Dorfman.

Surveys of Economic Theory, Resource Allocation, Vol III, p 29-74, Macmillan, London, England, 1966. 46 p, 5 tab, 40 ref.

Descriptors: *Operations research, Mathematical models, Linear programming, Systems analysis, Probability, Model studies. Identifiers: Measure of merit, Information theory,

Inventory models, Objective function.

The operations analyst, in contrast with the conventional business analyst, has a predilection for formulating his problems by means of formal mathematical models. By a model, the author means a symbolic description of a phenomenon in which its observable characteristics are deducted from simple explanatory first principles by manipulating symbols in accordance with the laws of some formal logic. Such analysts have a preference for symbolic, as opposed to verbal, modes of expression and reasoning. Operations research is not a descriptive science but a prescriptive one. A major part of the task of the operations analyst is to construct a 'measure of merit' for the operation he studies to accompany his formal description of it. The logical precision of the model enforces corresponding precision in expressing the objectives that the operation is intended to attain. The author discusses a number of aspects of the problem of model formulation. Then the problems of determining measures of merit or objective functions are examined. Operations research can be used advantageously in many sectors of the water area, examples would be water pricing, simulation models and demand forecasting. This article provides a general reference for the water researcher interested in using operations research methods. (See W70-03990). (Loeb-Rutgers) W70-03992

LINEAR THEORY,

All Souls Coll., Oxford (England). J. R. Hicks

Surveys of Economic Theory, Resource Allocation, Vol III, p 75-113, Macmillan, London, England, 1966. 39 p, 4 fig.

Descriptors: Linear programming, Input-output analysis, Mathematical studies, Equations. Identifiers: *Linear theory, Activity analysis, Game theory, Duality Theorem, Convexity.

The subject which the author discusses in this article concerns the group of techniques of linear programming, activity analysis, input-output, and theory of games. It is apparent, from the most casual inspection of these topics, that they are closely related. Further examination shows that they can be set around a recognizable core, which may be regarded as a restatement of a central part of conventional economic theory. It is the object of the author to isolate this core and to consider what there is that the economist, who has no intention of becoming a practitioner of the techniques, may learn from it. The phenomenon which is examined is the application to economics of a new kind of mathematics. This article has relevance to the water area in view of extensive use of these mathematical techniques in this sector. (See W70-03990). (Loeb-Rutgers) W70-03993

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: VOLUME I - THE WASTE MANAGEMENT

Bechtel Corp., San Francisco, Calif. For primary bibliographic entry see Field 05E. W70-04005

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: VOLUME II - CRITERIA FOR WASTE MANAGEMENT.

Bechtel Corp., San Francisco, Calif.
For primary bibliographic entry see Field 05E.

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: VOLUME III - TECHNICAL ASPECTS OF PIPELINING OF WASTE MATERIALS, Bechtel Corp., San Francisco, Calif. For primary bibliographic entry see Field 05E. W70-04007

6B. Evaluation Process

RELATIVE IMPORTANCE OF VARIABLES IN

RELATIVE IMPORTANCE OF VARIABLES IN WATER RESOURCES PLANNING, Geological Survey, Washington, D.C.; and Resources for the Future, Inc., Washington, D.C. I. C. James, II, B. T. Bower, and N. C. Matalas. Water Resources Research, Vol 5, No 6, p 1165-1173, Dec 1969. 9 p, 2 fig, 4 tab, 13 ref.

Descriptors: *Planning, *Water resources develop-Descriptors: *Planning, *Water resources development, *Statistical models, Statistical methods, Non-structural alternatives, Simulation analysis, Forecasting, Water quality, Estuaries, Model studies, Mathematical models, Markov processes, Probability, Economics, Legal aspects, Social aspects, Political aspects, Synthetic hydrology, Water pollution, Water supply.

Identifiers: *Sensitivity analysis, *Potomac River Fstuary

Four variables involved in the water resources planning decision characterized by hydrology, modeling of dissolved oxygen behavior in an estuary, projection of economic development, and water quality objective, were tested for sensitivity in the evaluation of a water resources system's performance. The results were obtained assuming a 25% range in economic projection, 1 mg/liter range in the dissolved oxygen objective, two separately developed models of estuarial dissolved oxygen behavior, and 50- and 10-year sequences of hydrologic data. The results of simulations of system operation with the different values of the planning variables were subjected to a four-way analysis of variance to partition the variance attributable to each planning variable. For the system under consideration, the relative importance of the variables in descending order is: (1) economic development projection, (2) water quality objective, (3) dissolved oxygen modeling, and (4) hydrology. (Knapp-USGS)

SOCIO-ECONOMIC

BIBLIOGRAPHY ON SOCIO-ECONOMI ASPECTS OF WATER RESOURCES, Battelle Memorial Inst., Columbus, Ohio. H. R. Hamilton, D. H. Owens, T. E. Carroll, A. R. Glenn, and B. A. Gilmour.

Available from the Clearinghouse as PB-189 420, \$3.00 in paper copy, \$0.65 in microfiche. Department of Interior, Office of Water Resources Research Bibliography, Mar 1, 1966. 453 p, 770 ref, append, 2 index. OWRR Contract No 14-01-0001-822.

Descriptors: *Bibliographies, *Abstracts, *Economics, *Social aspects, *Water resources, Social impact, Recreation, Water resources development, Water pollution control, Costbenefit analysis, Conservation, Control, Costs,

Data collections, Desalination, Planning, Manage-

Identifiers: Socio-economic aspects.

The purpose of this annotated bibliography is to ease the task of those desiring to review the literature pertaining to the economic aspects of water. The bibliography includes, but is not limited to, the literature in the following areas of interest: (1) The supply of and demand for water of various qualities including the competitive uses for industry, domestic, and recreation; (2) methods and applications of cost/benefit analysis, including those involving multiple-purpose water projects; (3) economic impact of water resources and water development projects; and (4) methods of determining economic values of sport fisheries, wildlife, and other aquatic outdoor recreation resources, as well as material on the social values of water-based outdoor recreation. The abstracts prepared for this bibliography are brief, noncritical, and indicative in nature. Each abstract has been given an identifying number, and has been indexed not only in terms of the central theme of the article, but also in terms of the material which is presented in support of the central theme. Following each abstract, all of the index terms deemed relevant to the article have been listed. In the subject index for this publication, two objectives were considered: (1) a comprehensive index for the immediate users, and (2) a deeper index for possible future inclusion in a computerized coordinate index system. (Knapp-USGS) W70-03714

CONSERVING RESOURCES AND MAINTAIN-ING A QUALITY ENVIRONMENT,
Agricultural Research Service, Beltsville, Md. Soil

and Water Conservation Research Div. For primary bibliographic entry see Field 05B. W70-03823

A COMPARATIVE ANALYSIS OF THE NET PRESENT VALUE AND THE BENEFIT-COST RATIO AS MEASURES OF THE ECONOMIC DESIRABILITY OF INVESTMENTS, British Columbia Univ., Vancouver. Bernhard Schwab, and Peter Lusztig.

Journal of Finance, Vol 24, No 3, p 507-516, June 1969. 10 p, 3 fig, 10 ref.

Descriptors: *Cost-benefit ratio, *Investment,

Constraints, Risks.
Identifiers: *Netted present value, *Present value,
Economic desirability, Aggregate benefit-cost
ratio, Netted benefit-cost ratio, Utility analysis.

Recent contributors in managerial finance have largely been concerned with the more challenging issues of valuation and capital structure. As a consequence, several controversial but less provoking issues remain shelved and unresolved. This paper is essentially directed at one such issue, the merits of alternative criteria for measuring the economic desirability of investments (both individual investment propositions and aggregate investment port-folios). The particular issue is the comparison of the net present value with various benefit-cost ratios. While these measures are based on the same ratios. While these measures are based on the same fundamental concept, recognizing the time value of money, and are, therefore, related to each other, they are different enough to yield contradictory results in a number of situations. It is the purpose of this article to analyze systematically all these various measures of economic desirability, defining the conditions under which they yield equivalent results and the conditions under which their results are contradictory, and as a consequence, to determine the validity of their application to the economic evaluation of investments. Such an analysis should lend itself to the evaluation of investments in the water area. (Loeb-Rutgers) W70-03825

COPING WITH UNCERTAINTY IN THE MAKE OR BUY DECISION, Marquette Univ., Milwaukee, Wis. Lloyd D. Doney.

Management Accounting, Vol 50, No 2, p 31-34, Oct 1968. 4 p, 7 tab.

Descriptors: *Risks, *Decision making, Probability, Fixed costs, Costs, Industrial production. Identifiers: *Make or buy decision, Decision cost. Probability weighing, Decision matrix.

The make or buy decision analysis is usually presented in an oversimplified manner in order that full attention may be given to the significant fact that decision-making most often requires a collection of figures that differ from those that are appropriate for purposes of income determination and inventory valuation. In pursuing this line of emphasis, the circumstances of the make or buy decision under consideration are usually void of any consideration of the uncertainty that typically surrounds the decision-making process in real situations. The purpose of this investigation is to add an uncertainty dimension to the typical make or buy decision analysis. A hypothetical example is given so as to demonstrate this extension of the make or buy decision analysis. This analysis might be applicable to the water area where uncertainty in both demand, supply and investment decisions is a prominent factor. (Loeb-Rutgers) W70-03826

INVESTMENT RETURNS BEFORE AND AFTER

Michigan Univ., Ann Arbor.

Harry Benford.
The Engineering Economist, Vol 10, No 4, p 1-16, Summer 1965. 16 p.

Descriptors: *Profits, *Taxes, *Costs, Investment, Operating costs, Interest rate, Financing, Loans, Depreciation, Economics, Cost repayment, Capital.

Identifiers: *Corporations, *Rate of return, Disposal value, Equity capital, Fast write-off.

This article attempts to explain the influence of the corporate profits tax on levels of profitability and the annual cost of capital. This topic should be of interest to the water resource planner due to the corporate structure of many water utilities and the effects of the tax as felt throughout the entire economy, (i.e. through changes in the price of capital). The author considers a simple case where the depreciation period for taxes equals the life of the investment, the investment is all equity capital and there is a negligible disposal value. He then moves on to the case where the depreciation period for taxes may be shorter than the probable useful life of the investment and the investment is raised throughout a bank loan. The last case studied is that where the depreciation period exceeds the loan period. The author concludes with some numerical examples to illustrate the concepts developed. (Murphy-Rutgers)
W70-03827

MAXIMUM CRITERION, **PROSPECTIVE** VALUE

Stanford Univ., Calif. R. V. Oakford, and G. J. Theusen. Engineering Economist, Vol 13, No 3, p 141-164, Spring 1968. 24 p, 9 tab, 10 ref.

Descriptors: *Investment, *Engineering, *Economics, *Growth rate, *Costs, Budgeting, Decision making, Computers, Discount rate, Economic evaluation, Marginal utility, Dividends, Value, Time, Optimization, Capital, Data gathering

Identifiers: *Prospective value, *Opportunity costs, Capital budget, Expectations, Cash flows, Dispursements, Receipts, Incomplete information.

This article analyzes the logic of the capital budget decision in two different situations. In both cases the decision-maker has full knowledge of his current investment opportunities. In one case he also knows his future investment opportunities, while in the other he only knows his expectations about these future opportunities. The article presents a discussion of the capital growth (or discount) rate that should be used in determining whether a marginal increment of investment should be accepted or rejected. The discussion results in the presentation of a capital-budgeting decision criterion called the Maximum Prospective Value Criterion. This criterion is designed to select the investments that have maximum prospective value to the decisionmaker, given the information he has at hand. This goal is a general one in public investment decisions including water resource projects. Accordingly, researchers in water investment decision analysis will be interested in this article. (Murphy-Rutgers) W70-03828

ON SUBSIDIES TO SPEED THE RATE AT WHICH TECHNOLOGIES ARE DEVELOPED. Office of the Secretary of the Treasury, Washington, D.C.

Laurance C. Rosenberg. Engineering Economist, Vol 12, No 1, p 1-21, Fall 1966. 21 p, 1 tab, 3 fig, 9 ref.

*Government, *Research Descriptors: development, *Water desalting, *Technology, Profits, Budgeting, Investment, Financing, Optimization, Correlation, Costs, Prices, Capital cost, Loans, Interest rate.

Identifiers: *Subsidies, *Isotechnology curves, Investment criteria, Social optimum, Rate of return.

The direct financing, by the U S Government, of the technology of water-desalting devices is largely responsible for its rapid development. This and other cases mentioned are areas where government other cases mentioned are areas where government sponsors R and D almost completely and the technology is almost wholly utilized by the private sector. This paper explores an R and D investment decision model with the aim of determining the impact on its variables of some possible subsidy methods that might be used to induce an increased rate of development of specific technologies by private industry. The author constructs a profit-maximizing model for R and D investments, using capital-budgeting theory as its basis. Its implication for subsidy methods of the government are discussed and the impact of these methods, when investment criteria other than the profit maximizing model is used, are mentioned. The importance of government subsidies in water resource development should make this article useful to the water resources investigator. (Murphy-Rutgers) W70-03830

IS RESOURCE ECONOMICS UNORTHODOX, Resources for the Future, Inc., Washington, D.C.

Orris C. Herfindahl. Journal of Soil and Water Conservation, Vol 24, No 1, p 10-11, Jan-Feb 1969. 2 p.

Descriptors: Economics, Political aspects, Natural resources, Resource allocation, Demand, Costbenefit analysis, Decision making. Identifiers: *Resource economics.

The author comments on a paper by Sargent in the same journal and argues that the relevant economic and political theory is the same for all applied fields of economies, of which natural resources may be viewed as one. The author contends that the market is the prime resource allocating system for the economy including the natural resource area. However, the fact that the market will not solve all problems is admitted. Often, the pursuit of self-interest will yield less than desirable results. However, it would be wrong to blame the market system for these misallocations. Contrary to Sargent's assertion, demand can be studied and estimated and may possibly suggest procedures that will enable us to reap some of the results generated by market forces. The 'conventional' economist working on resource problems may sometimes err because he does not sufficiently understand the physical and biological relationships involved and because he is not accustomed to working with problems in which benefits and costs external to the decision making unit occupy so prominent a place. The remedy is

Field 06-WATER RESOURCES PLANNING

Group 6B—Evaluation Process

not to abandon conventional economics but to learn enough about the problem at hand to apply it. This problem is apparent in the water area where conventional economic theory must be supplemented in many instances by sociological and biological data to improve water resource allocation. (Loeb-Rutgers)

ON INDEPENDENCE POSTULATES CON-CERNING CHOICE,

Philippines Univ., Manila.

Jose Encarnacion.

International Economic Review, Vol 10, No 2, p 134-140, June 1969. 7 p, 2 fig, 11 ref.

Descriptors: *Consumption, *Economic evalua-tion, *Uncertainty, Maximinzation, Probability, Mathematical studies, Decision making, Profits, Prices, Value, Marginal utility.

Identifiers: *Preference ordering, *Independence, *Utility function, Sure-thing principle, Strong independence axiom, Impossibility theorem, Lexicographic ordering.

This paper argues that the independence postulates assumed by Savage, Koopmans, and Arrow are not valid when choice is essentially multidimensional. Specifically, these postulates are violated by certain lexicographic preference orderings which are themselves consistent. The author shows that the 'sure-thing' principle used by Savage presupposes that choice is unidimensional, i.e., representable by a real-valued utility function. Koopmans employs a postulate similar to Savage's but the author shows that his conclusion regarding zones of impatience is not the only possible conclusion and the more correct one would be that the utility function is not real-valued. The binary choice condition used by Arrow is wrong in restricting group choice as a function only of individual choices among the alternatives themselves. Due to the importance of understanding consumer behavior as it applies to water demands this article should be of use to the water researcher interested in the basic theoretical foundations of demand study. (Murphy-Rutgers)

GENERALIZED PRODUCTION FUNCTIONS,

Chicago Univ., Ill.; and State Univ. of New York,

A. Zellner, and N. S. Revankar.

The Review of Economic Studies, Vol 36, No 106, p 241-250, Apr 1969. 10 p, 2 tab, 10 ref, 1 append.

Descriptors: Average costs, Return to scale.
Identifiers: *Generalized production function,
Elasticity of substitution, Output, Average cost
curves, Labor's share, Maximum likelihood esti-

In this paper generalized production functions (GPF's) are introduced where the generalization referring to what is assumed about not only the elasticity of substitution but also the behavior of the returns to scale. That is, given a neo-classical production function with a given elasticity of substitution (constant or variable), it is shown how this function can be transformed to yield a neo-classical GPF with the same elasticity of substitution and with the returns to scale variable and satisfying a preassigned relationship to the output level. For example, a GPF may have a constant elasticity of substitution and returns to scale which diminish in a preassigned fashion with the level of output. This contrasts with many current production functions used in applied studies which assume the same returns to scale at all levels of output. Since returns to scale may be different at different scales of operation, GPF may be useful in analyzing data relating to production. Production functions are often estimated in the water research area and as such, the GPF analysis may prove to be applicable to water problems. (Loeb-Rutgers) W70-03833

A COST MODEL FOR COASTAL SHIPPING, A NORWEGIAN EXAMPLE.

Institute of Transport Economy, Oslo (Norway).

Journal of Transport Economics and Policy, Vol 3, No 2, p 195-221, May 1969. 27 p, 4 fig, 5 tab.

Descriptors: Ships, Costs, Competition, Return, Fuels, Oil, Maintenance, Claims, Insurance, Capital costs, Indirect costs, Investment. Identifiers: *Cost model, *Coastal shipping, Air

service, Road service, Passenger ships, Cargo ships, Cargo handling costs, Port dues.

The sea has always been a natural route for comminications for Norway. However, the importance of sea transport is gradually being eroded. Extensive road building in the coastal districts is enabling bus service to replace the shorter shipping routes, while the longer ones are threatened by competition from the air. Coastal shipping includes scheduled services, ferries and tramp traders. This article analyzes the economics of the scheduled shipping services and develops cost-performance relationships for both construction and operating costs of modern ships. It also considers how far sea transport can hold its own against road and air competition. This discussion will be relevant to water areas such as the Great Lakes as well as the coastal United States. (Loeb-Rutgers) W70-03834

THE IMPACT OF INDUSTRIAL LINKAGES ON GEOGRAPHIC ASSOCIATION, North Carolina Univ., Chapel Hill.

Charles E. Richter.
Journal of Regional Science, Vol 9, No 1, p 19-28,
Apr 1969. 10 p, 1 tab, 17 ref.

Descriptors: Employment, Correlation analysis, Statistical methods.

Identifiers: *Industrial linkages, *Geographical association, External economics, Industrial location, Coefficient of correlation.

The external economies associated with industrial linkages have frequently been cited as possible causes of economic agglomeration and the uneven geographic distribution of economic activities. It is often asserted that industries locate near their principal markets of sources of materials because high initial transport rates usually discourage inter-mediate locations. Also advantages in communications encourage important buyers and sellers to locate in geographic proximity. Nevertheless, because of the lack of data and the difficulty of separating out the linkage effect on industrial location, no studies have effectively measured the importance that industrial linkages may have on geo-graphic association between industries. The purpose of this paper is twofold: (1) a new and better measure of geographic association is developed, and (2) the measurement is used to evaluate the importance of linkages on the locations of manufacturing activities. An extension of the topic of this paper might provide insights in the problem of industrial location and its relation to water supply and conditions. (Loeb-Rutgers)

THE DYNAMIC PROGRAMMING APPROACH TO WATER-RESOURCES DEVELOPMENT.

California Univ., Los Angeles. Warren A. Hall, and Nathan Buras. Journal of Geophysical Research, Vol 66, No 2, p 517-520, Feb 1961. 4 p, 11 ref.

Descriptors: *Economics, *Optimization, *Water resource development, *Dynamic programming, Benefits, Water resource allocation, Mathematical studies, Rivers, Multipurpose projects, River development, Water supply, Prices, Reservoirs, Computers, Irrigation, Flood control. Identifiers: *Economic returns, Viable alternatives.

The author blames the present poor state of affairs in river development to the inability of those

responsible to consider the large numbers of alternatives with precision. He proposes dynamic programming as a way in which calculations can be reduced to a form which is readily handled by a computer in a relatively short time and one in which optimum policy is computed for every possible level of resource development. In this paper dynamic programming is applied to the optimizing process to permit determination of the 'optimum' policy over a very broad range of alternatives. The solution arrived at provides the optimum allocation of the water resource. The author states that this method may be used on all tractable portions of the individual problems in order to increase the economic returns. (Murphy-Rutgers)

SOCIOECONOMIC STATUS: A RE-EXAMINA-TION OF ITS DIMENSIONS, Columbia Univ., New York.

Jerome B. Gordon.

The Journal of Human Resources, Vol 4, No 3, p 343-359, Summer 1969. 17 p, 7 tab.

Descriptors: Regression analysis, Welfare, Costs, Performance, Age, Income, Employment, Labor

supply.

Identifiers: *Socioeconomic status, Cobb-Douglas production function, Social welfare, Intensity of skill preparation, Educational attainment, Census SES score, Duncan SES score, GED/SVP code.

It is the author's contention that social scientists are going to be hard put to develop adequate measures of effectiveness or criteria for choosing amongst alternative programs dealing with max-imizing social welfare and well-being, or minimiz-ing the costs associated with their delivery. Criteria of choice or measures of effectiveness must be transformations of measures of performance, not the measures of performance themselves. Although one cannot obtain ideal measures of effectiveness, one is not prevented from developing and applying approximate measures. The purpose of this paper is to present some empirical work in the direction of devising a new index of socioeconomic status and its impact on weighting the components of such an index of socioeconomic status. Multiple regression analysis is used to develop a Cobb-Douglas production function for estimating socioeconomic status. Socioeconomic variables have proven to be signifi-cant in studies pertaining to the demand for out-door recreation facilities and other water uses. As such, this article might prove helpful in further studies pertaining to this section of water analysis. (Loeb-Rutgers)
W70-03837

THE OPTIMALITY OF LOCAL SUBSIDIES IN REGIONAL DEVELOPMENT PROGRAMS, West Virginia Univ., Morgantown. Carl W. Hale.

The Quarterly Review of Economics and Business. Vol 9, No 3, p 35-50, Autumn 1969, 16 p.

Descriptors: *Optimization, *Regional analysis, *Economics, Interest rate, Taxes, Marginal cost, Financing, Capital investment, Government sup-

Identifiers: *Local subsidies, Unemployment, Minimum wage, Subsidization, Rate of discount.

The concept of local subsidies to private industry is examined. The author wishes to examine three assumptions: (1) that such subsidies act as a foil to institutional impediments to market adjustments; (2) that the subsidies actually attract new firms or branch plants to the community offering; and (3) that no national or regional repercussions of a seri-ous nature result from such practices. The applica-bility of benefit-cost analysis in attempting to mea-sure the rate of return of such subsidies, is also examined. The use of regional economic analysis in water development studies along with the applicability of the benefit-cost techniques to water resources make this article of interest to the water resource planner. The author shows that optimal

Evaluation Process—Group 6B

decisions made with regard to regional development programs cannot be made at the community level through the unrestricted use of local subsidies. (Murphy-Rutgers) W70-03838

PRODUCTION, CONSUMPTION, AND EXTER-

Resources for the Future, Inc., Washington, D.C.

R. V. Ayres, and A. V. Kneese.
American Economic Review, Vol LIX, No 3, p 282-297, June 1969. 16 p, 1 fig, 1 tab, 31 ref.

Descriptors: *Economic analysis, *Industrial production, Equilibrium, Pollution, Input-output analysis, Inventory, Natural resources, Water resource development, Taxes, Investment, Transportation, Sewage disposal, River flow, Wastes, Streams, Public health.

Identifiers: *Water residuals, *Production, *Consumption, *Welfare economics, *Externalities.

This article proposes that the externalities associated with the disposal of residuals resulting from the consumption and production processes have an economic significance which increases with economic development. Consequently, the ability of the ambient environment to receive and assimilate them in an important natural resource of increasing value. Such externalities cannot be properly dealt with by isolating environmental media such as water. Restrictions such as taxes are essential in an environmental quality management program, but must be used in conjunction with public investment programs, transportation systems, sewage disposal and river flow regulations. To attain this end, this article presents a model designed to develop improved measures of external costs and systematic methods of forecasting emissions of external-cost producing residuals, the technical and economic tradeoffs between them and the effects of the recycle on environmental quality. Due to its direct application to water this model has important implications for water research methods dealing with evaluations of water pollution control programs. (Murphy-Rutgers) W70-03843

INSTITUTIONAL FACTORS LAND AND WATER DEVELOPMENT, LOWER RIO GRANDE VALLEY, TEXAS, Texas A and M Univ., College Station.

Warren L. Trock.

Water Resources Research, Vol 5, No 6, p 1364-1366, Dec 1969. 3 p, 1 ref. OWRR Project No B-

Descriptors: *Water resources development, *Institutional constraints, *Water law, *Water rights, *Rio Grande, Land management, Water management (Applied), Political constraints. Identifiers: Lower Rio Grande Valley (Tex).

Among the many institutional factors that com-Plicate land and water development in the lower Rio Grande valley are (1) uncertainties in water rights, (2) a proliferation of special districts, (3) in-appropriate water management policies among disappropriate water management poincies among districts, and (4) numerous governmental entities involved in planning and administering water resources. It is recommended that the people of the valley urge and facilitate an early adjudication of rights. Improvements in irrigation and drainage could be achieved by reorganizing the special districts. A master district for the three-county are may be a logical alternative to the many districts that now exist. Rehabilitation of irrigation systems, including installation of water meters, will contribute to the management of water supplies. (K-napp-USGS) W70-03865

USES OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES: CHAPTER IV, Northeastern Univ., Boston, Mass. Dept. of Civil

Engineering.

For primary bibliographic entry see Field 05B. W70-03934

COST, PRECISION, AND VALUE RELATION-SHIPS OF DATA COLLECTION AND DESIGN ACTIVITIES IN WATER DEVELOPMENT PLANNING.

California Univ., Berkeley. Hydraulic Lab. For primary bibliographic entry see Field 04B.

STRATEGY FOR MICHIGAN WATER RESOURCES MANAGEMENT: A SYSTEMS AP-

Technology Planning Center, Inc., Ann Arbor,

James C. Kellogg.

Technology Planning Center, Inc, Ann Arbor, Mich, 1966. 87 p, 7 fig, 10 ref, 3 append.

Descriptors: *Water resources development, *Systems analysis, *Models, *Michigan, *Decision making, *Water demand, Water supply, Interstate, Technology, Programs, Costs, Benefits.

The study presented a strategy for optimum management of Michigan State Water Management. Using a systems analysis approach the strategy was developed as an outline for a Comprehensive Master Plan (CMP). The outline was divided into four steps: (a) the roles and responsibilities of Michigan State in water management were defined as either regional, multi-state, inter-regional, in-terstate or intrastate; (b) elements of water resource management, i.e., demands for water resources, water resource supply, technology that could be applied to the water resources problem, and the management capabilities available, were defined; (c) a Comprehensive Master Plan model was established for Michigan water resource objectives; and (d) alternative programs were presented, providing as much information as possible on their costs and benefits to those who make state water resource decisions. (Thiuri-Cornell)

DESIGN AND COST OF ION-EXCHANGE SOF-TENING FOR A 50-MGD SEA-WATER EVAPORATION PLANT,

California Univ., Berkeley. Sea Water Conversion

For primary bibliographic entry see Field 03A. W70-03945

BIOSTIMULATION AND TOXICITY CRITERIA AND APPLICATIONS IN DESIGN-PRESENT PRACTICE AND FUTURE POSSIBILITIES, Engineering-Science, Inc., Oakland, Calif. Philip N. Storrs.

Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 222-226.

Descriptors: *Eutrophication, *Toxicity, *Water quality, *Design criteria, *Planning, *Forecasting, Analytical techniques, Physiological ecology, Minnesota, Bioassays, Growth stages, California, Benthos, Nutrients, Agricultural wastes, Algae, Water pollution effects, Plankton, Municipal wastes, Industrial wastes, Fish. Identifiers: *Biostimulation, *Design applications, *Water quality criteria, Growth response, National Water Quality Lab, Duluth (Minn), University of California, Berkeley (Calif), Community structure, San Francisco Bay-Delta Program, Relative toxicity, Species diversity indices, San Francisco Bay, Environmental stresses, Relative biostimulant content, Median lethal tolerance limits.

Problems of water quality management are becoming increasingly complex due to constantly changing criteria. Numbers of criteria increase as does possibility of expressing them quantitatively. The problem is also complicated by increasing diversity of water uses. Current research efforts in biotoxicity and biostimulation are directed toward understanding of mechanisms involved, and developing or improving control methods. That bioassays of toxicity suffer from defects is acknowledged and attempts to circumvent these deficiencies have included assessment of various sublethal organismic responses, development of longer tests over total life history of various organisms, and determination of effects on structure of biological communities. Recent studies have introduced the concept of Relative Toxicity (RT), defined as volume flow rate of a discharge divided by its 48-hour median lethal tolerance limit, developed by bioassays.

Analogizing with studies of biotoxicity suggests a program of biostimulation study in specific receiving waters, which involves identification of potential biostimulant sources; bioassays of growth of indigenous algae under conditions simulating environment; development of parameter, Relative Biostimulant Content (RBC), analogous to RT; determining in situ growth and biomass of algal populations; sampling and calculating RBC of eiving waters; determining relationship between RBC and population changes. (See Vol 3, No 7, Field 5C, entry W70-02775). (Eichhorn-Wisconsin) W70-03982

THE WATERSHED AS AN ENTITY FOR

PLANNING,
Tennessee Valley Authority, Knoxville. Div. of Agricultural Relations.

Watershed problems.

Fletcher E. Riggs.
In: Economics of Watershed Planning, p 59-67, lowa State University Press, Ames, 1961. 9 p, 1 fig.

Descriptors: *Watersheds, *Planning, Water resources, Tennessee River, River basins, Drainage, Benefits, Costs, Flood control. Identifiers: *Watershed planning, Regional economic development, Physical characteristic,

Watershed planning has been primarily concerned with narrow purposes of land and water resources development. In a few instances these objectives have been broader. The Tennessee River watershed has provided the geographic context for a broad program of regions! a broad program of regional economic development. However, the focus in this paper is on the usefulness of the watershed in planning for the development of land and water resources. The author discusses the physical characteristics of the watershed, watershed problems, and the entity for land and water resources planning. The author concludes that the form of organization for basin-wide planning and for unification of activities in the watershed should be of the river basin type. (See Vol 2, No 14, Field 6B, entry W69-05718). (Loeb-Rutgers) W70-03987

COMMENT ON, 'THE WATERSHED AS AN ENTITY FOR PLANNING',

Kentucky Univ., Lexington. John C. Redman.

In: Economics of Watershed Planning, p 68-69, Iowa State University Press, Ames, 1961. 2 p.

Descriptors: *Watersheds, *Planning, Flood control, Costs, Benefits, Size.
Identifiers: Optimum size, Public Law 566.

The question of determining the optimum size watershed is brought up by the author. The author further suggests the examination of the hypothesis that as a watershed becomes larger, it loses (or gains) some claim as the appropriate entity for planning. As watersheds increase in size, social, political, and economic institutions may become more important. If so, more concern should be expressed for other entities, such as a trade or market area. Watershed plans must be coordinated with market plans; often they must be planned simul-taneously. Such an arrangement brings together a

Field 06—WATER RESOURCES PLANNING

Group 6B—Evaluation Process

group, with similar backgrounds and problems, who have common goals. The whole community should understand the proposal if the project is to be effective. The author suggests that Riggs should have mentioned the influence of purpose and the level of desired flood protection. Like Riggs, the author favors a river basin type of development but only under special conditions. Because of organizational problems, the author is inclined to think that the small watershed has more to contribute than Riggs had indicated. (See Vol 2, No 14, Field 6B, entry W69-05718). (Loeb-Rutgers) W70-03988

COMMENT ON, 'MESHING WATERSHED DEVELOPMENT WITH RIVER BASIN DEVELOPMENT',

Michigan Univ., Ann Arbor. Lyle E. Craine.

Economics of Watershed Planning, p 84-86, Iowa State University Press, Ames, 1961.3 p.

Descriptors: *Watersheds, Planning, River basin,

Cost-benefit analysis.
Identifiers: Guiding ideas, Waterservices, Water production planning, Meshing.

The author suggests several specific concepts which may provide guides in designing relationships between watershed development, river basin development, and planning. First, the integrity of the drainage basin as a development unit is invio-late only if the basin is viewed as a production facility for water services. Second, the problem is to determine the extent and methods of articulating water production planning with comprehensive planning, rather than to force one to absorb the other. Third, the extent and method of articulation will differ in different situations, and a major determinant will be the expressed need that motivates a drainage basin development. The author then postulates several types of situations. Fourth, the problem of meshing watershed and river basin development, like that of relating water development to comprehensive planning, also calls more for articulation than for integration. Fifth, the concepts of benefit-cost analysis must be extended beyond the calculus of efficiency. (See Vol 2, No 14, Field 6B, entry W67-05718). (Loeb-Rutgers) W70-03989

SURVEYS OF ECONOMIC THE RESOURCE ALLOCATION, VOLUME III.

London, England, Macmillan and Co Limited, 1966, 207 p.

Descriptors: *Resource allocation, Economics, Decision making, Operations research, Cost-

benefit analysis.

Identifiers: *Economic theory, Linear theory, Household behavior.

The surveys printed within this volume have been produced by the American Economic Association and the Royal Economic Society. The purpose of such a volume is to make the literature pertaining to the advances in theories in economics more reasily available to students, research-workers and teachers. The topics included in this volume are: theories of decision making, operations research, linear theory, research on household behavior, and cost benefit analysis. These subjects have been found to be useful tools in the water area and this book provides the researcher with a useful summary and bibliography in the areas examined. (See also W70-03991 thru W70-03994). (Loeb-Rutgers) W70-03990

THEORIES OF DECISION-MAKING ECONOMICS AND BEHAVIORAL SCIENCE, Carnegie Inst. of Tech., Pittsburgh, Pa. Herbert A. Simon.

Surveys of Economic Theory, Resource Allocation, Vol III, p 1-28, Macmillan, London, England, 1966. 28 p, 71 ref.

Descriptors: *Decision making, *Economics, *Psychological aspects, Behavior, Probability, Computers, Risks.

Identifiers: Behavioral science, Utility, Empirical studies, Normative applications, Binary choice experiment, Probabilistic preferences, Satisfying, Maximizing, Business behavior, Game theory, Bargaining, Expectations.

The role of psychology in the realm of economics is discussed. As the complexity of man's environment increases we need to know more and more about the mechanisms and processes that economic man uses to relate himself to that environment and achieve his goals. How close we wish to interweave economics with psychology depends on the range of questions we wish to answer and our assessment of how far we may trust the assumptions of static equilibrium as approximations. In both the theory of utility and its application to choice under uncertainty (as well as in consumer saving and spending) and in the macroeconomic sector (where one attempts to understand the process of making business decisions) notions of adaptive and satisfying behavior are challenging the classical picture of the maximizing entrepreneurs. Psychologists and economists have been applying a wide variety of approaches to the study of the formation of expectations. The author suggests that as economics finds it more and more necessary to understand and explain disequilibrium as well as equilibrium, it will find an increasing use for the digital computer for communication with psychology and sociology. The ideas of expectations and uncertainty play an important role in water demand and investment decisions. This article is relevant to the water area by reviewing the multidiscipline activity in areas traditionally considered economic in nature. (See W70-03990) (Loeb-Rutgers)

RESEARCH ON HOUSEHOLD BEHAVIOR.

Illinois Univ., Urbana.

Robert Ferber.

Surveys of Economic Theory, Resource Allocation, Vol III, p 114-154, Macmillan, London, England, 1966. 41 p, 170 ref.

Descriptors: Income analysis, Economics, Income,

Expenditures, Decision making.
Identifiers: *Household behavior, Spending, Saving, Absolute income hypothesis, Relative income hypothesis, Socioeconomic characteristic, Expechage tations, Asset holdings.

The purpose of this paper is to survey the main empirical research of recent years on household behavior. Although the emphasis is on empirical work the principal theoretical developments are also reviewed. The article relates to consumer behavior at the microeconomic level. Although various parts of the discussion present the problems of aggregation and of macroeconomic relations, comprehensive coverage of these areas is outside the present article. Furthermore, the emphasis is on spending and saving behavior rather than on the income or other economic or non-economic behavior aspects of the consumer. At the same time this article transcends the usual boundaries of economics, to cover the growing importance of other disciplines in this area, particularly marketing, sociology and psychology. This article would be relevant to the water area for studies analyzing consumer demand for water. (See W70-03990). (Loeb-Rutgers) W70-03994

WATER RESOURCES MANAGEMENT AND PUBLIC POLICY. Washington Univ., Seattle.

Edited by Thomas H. Campbell and Robert O. Sylvester. Seattle, University of Washington Press, 1968. 253 p.

Descriptors: *Water quality, *Water resource development, Population, Pollution, Water supply, Economics, Waste disposal, Natural resources, Re-

gional analysis, Fisheries, Management, Govern-ment, Water transfer, Cost-benefit analysis, Surface water, Economic efficiency, Economic feasibility, Legal aspects, Model studies, Hydrology, Aquifer, Lakes, Industrial wastes, Water law, Water resource planning.

Identifiers: Agricultural production, Land development, Public policy.

This book is an attempt to outline, for laymen, academicians, legislators, and the public, many of the relevant issues that should be considered in the management of water resources. It is based on papers prepared by the numerous contributors on the problems involved in water quality and water supply. Project analysis and agricultural demand for water in the West is discussed as well as the development of surface waters of California's Central Valley; using benefits and economic efficiency as the yardstick. The concept of benefit-cost is then examined in detail. Several papers emphasize the need for research and tell of some results on the Columbia River and the Pullman-Moscow aquifer. The methodology of establishing water-quality standards is examined, the economics of the problem discussed and an empirical example is proing are presented, along with the industrial views about pollution. (See also W70-03996 thru W70-04000). (Murphy-Rutgers) vided. The techniques of receiving-water monitor-

WATER FOR WESTERN FEDERAL IRRIGA-TION PROJECTS, Washington State Univ., Pullman.

For primary bibliographic entry see Field 03F. w70-03996

WATER RESOURCE DEVELOPMENT IN CALIFORNIA: THE COMPARATIVE EFFICIENCY OF LOCAL, STATE AND FEDERAL AGENCIES, California Univ., Berkeley.

For primary bibliographic entry see Field 04A.

THE ECONOMICS OF AGRICULTURAL WATER USE, Washington Univ., Seattle.

Gardner Brown.

Water Resources Management and Public Policy, Seattle, University of Washington Press, p 30-43, 1968. 14 p, 15 ref.

Descriptors: *Irrigation, Economic analysis, *Optimization, Cost-benefit analysis, Pricing, Government, Demand, Water supply, Water transfer, Economic efficiency, Bonds, Government supports, Social aspects, Water law, Marginal cost, Profits, Economic evaluation.

Identifiers: *Water agencies, *Externalities.

Water is another input or factor of production which the farmer, acting as the firm, employs to produce an output or combination of outputs. Some examples of the application of economic Some examples of the application of economic analysis are given, but the economists' assumptions underlying the analysis are not always fulfilled. An account of these complications and the steps which are being taken to overcome them is presented in the paper. The author then examines the policies of the Bureau of Reclamation as well as their consequences from the viewpoint of economic theory. A brief discription of the pricing policies associated with the California State Water Project is then provided and a comparison made between the practices of the Bureau of Reclamation and the California Department of Water Resources. The author concludes with an evaluation of the need for careful and imaginative economic analysis to estimate the magnitudes and distribution of costs and benefits associated with competing water policy choices. (See W70-03995) (Murphy-Rutgers) W70-03998

BENEFIT-COST ANALYSIS: A CRITERION FOR SOCIAL INVESTMENT,

Stanford Univ., Calif.

Robert C. Lind.

Water Resources Management and Public Policy, Seattle, University of Washington Press, p 44-64, 1968. 21 p, 9 ref.

Descriptors: *Cost-benefit analysis, *Economic evaluation, *Social aspects, *Water resource development, Social welfare, Economic efficiency, Income, Regional analysis, Prices, Profits, Capital. Decision making, Discount rate, Economics, Irrigation, Government, Consumption, Interest rate, Flood control, Demand. Identifiers: *Social investment, Time preference.

The general procedure of benefit-cost analysis is outlined and the rationale behind the procedure is explained. The desired measure of benefits and costs is discussed, as are the conditions under which market prices can be used in measuring benefits and costs. The relationship between the benefit-cost criterion and economic efficiency is brought out and the relation of the benefit-cost to profitability criterion is discussed. The special characteristics of social investment are then developed as are the difficulties that these characteristics create for the measurement of benefits and costs. The problem of incorporating risk in the decision rule is discussed in connection with the social rate of discount. The last section presents conditions under which benefit-cost analysis may be applied and points out several cases where market imperfections may complicate the problem of mea-suring costs and benefits. As an area of social investment where benefit-cost analysis is important, water resource development depends on the application of these principles and the author presents several examples of their application in the water area. (See W 70-03995) (Murphy-Rutgers) W70-03999

ECONOMIC ANALYSIS IN WATER QUALITY MANAGEMENT, Washington Univ., Seattle.

James A. Crutchfield.

Water Resources Management and Public Policy, Seattle, University of Washington Press, p 129-138,

Descriptors: *Waste disposal, *Economic analysis, *Cost minimization, Statistics, Water quality, Management, Economic efficiency, Demand, Water supply, Pollution, Costs, Benefits, Risks, Government, Decision making, Economic feasibili-

Identifiers: *Private costs, *Social costs, Uncertainty.

The principals underlying optimal and suboptimal systems of water-quality management is discussed. Examination is also conducted on the effects of the divergence of private and social costs and benefits in water use as well as the complications introduced by technological economies of scale in waste disposal. The contribution of economic analrisk and uncertainty is discussed along with the problem of the extent to which the uses impaired problem of the extent to which the uses impaired by water-quality degradation are of the types most difficult to measure in economic terms. These difficulties, coupled with the wide areas of incomplete knowledge of highly variable physical parameters, suggest that water-quality management must in practice be limited to suboptimal systems designed to minimize aggregate waste-disposal costs subject to one or more constraints. (See W70-03995) (Murphy-Rutgers) W70-04000

AN ACTIVITY ANALYSIS OF NON-STRUC-TURAL PLAIN MANAGEMENT ALTERNA-TIVES: CHAPTER IV, Wisconsin Univ., Madison. Water Resources

For primary bibliographic entry see Field 06F. W70-04003

NATIONAL RIVERS AND HARBORS CON-GRESS SUPPORTS COMPREHENSIVE GRESS SUPPORTS A COMPREHENSIVE WATER RESOURCES DEVELOPMENT PRO-GRAM,

For primary bibliographic entry see Field 06E. W70-04043

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER DEVELOPMENT FUND.

Mo Ann Stat secs 256.280 thru 256.370 (Supp 1970).

Descriptors: *Missouri, *Water resources development, *Water allocation (Policy), *Water management (Applied), Municipal water, Legal aspects, Legislation, Industrial water, Water storage, Water supply, Water resources, Reservoirs, Public utilities, Federal government, Administrative agencies, Water distribution (Applied), Water conservation, Water utilization, Project planning, Local govern-

The Missouri Water Development Fund is created for the purpose of financing the storage of the municipal and industrial water supply in public works projects and in works constructed with federal assistance. The Water Resources Board is responsible for proper distribution and allocation of the state-owned water supply. The Water Resources Board may sell or sublet water from storage. The Board may, with approval of the General Assembly, sell or sublet water from the municipal and industrial water supply to special-benefit users at cost. The Water Resources Board, acting on behalf of the state, must protect public interests in federal reservoirs. (Powell-Florida) W70-03770

MISSOURI FEDERAL WATER PROJECTS RECREATION FUND.

Mo Ann Stat secs 258.500 thru 258.540 (Supp

Descriptors: *Missouri, *Conservation, *Recreation, *Water resources development, Legal aspects, Legislation, Federal government, State governments, Natural resources, Project purposes, Water conservation, Water resources, Water utilization, Appropriation, Wildlife conservation, Fish conservation, Benefits, Federal project policy, Reservoirs.

The Missouri Federal Water Projects Recreation Fund is created. Money is appropriated from the fund for purposes of paying non-federal costs associated with the enhancement of recreation and fish and wildlife benefits on federal reservoir lands and waters. (Powell-Florida) W70-03771

THE WATER SUPPLY SYSTEM UP TO A.D.

2001, Manchester Business School (England).

Douglas Wood. Journal of Industrial Economics, Vol XVIII, No 1, p 64-75, Nov 1969. 12 p, 3 tab.

Descriptors: *Water supply, *Water demand, *Costs, *Cost minimization, *Economic feasibility, *Demand, *Joint costs, Nuclear energy, Technology, Cost-benefit analysis, Electrical power costs, Economics, Water purification, Reservoirs, Water

distribution, Pricing.
Identifiers: *Barrage, *Joint production, *Opportunity costs, *Social costs.

The article attempts to deal with the prospective water supply deficit for the year 2000. Although the example used in this study is the English water problem, the techniques and problems studied are of general significance for the water resource planner. The determinants of the domestic, industrial and agricultural demand are explained and

estimates made. A number of ways of fulfilling this demand are explained along with their feasibility from a cost-benefit point of view. It appears that, when considering social costs and benefits, a barrage has a clear advantage over any conventional scheme. The problems associated with joint production of electricity and water are studied with special concentration on allocation of costs. The only valid economic technique is to use the opportunity cost of securing an equivalent production from an alternative source. This method of cost allocation is studied and conclusions are reached regarding the most economically feasible method of meeting water demand. (Murphy-Rutgers) W70-03842

RETURNS TO SCALE AND COST CURVES, Washington Univ., Seattle.

Lowell Bassett.

The Southern Economic Journal, Vol XXXVI, No 2, p 189-191, Oct 1969, 3 p, 1 fig.

Descriptors: *Returns to scale, *Costs, *Input-output analysis, Economics, Cost minimization, Prices, Average costs, Mathematical studies, Productivity, Economies of scale.
Identifiers: *Production functions, Indifference

curves, Homogeneous functions.

The article attempts to clarify some of the confusion about the relationship between returns to scale and per unit economic costs. Increasing returns to scale implies that average cost is decreasing; however, constant returns permit either constant or decreasing per unit costs while the condition of decreasing returns is consistent with increasing, constant or decreasing average costs. Thus, it is shown that knowledge of the slope of the average cost curve is not sufficient justification for saying anything about returns to scale for the general class of production functions. Owing to the importance of production functions and costs analysis in water resource development, this article should prove useful to the water resource planner. (Murphy-Rutgers) W70-03844

6D. Water Demand

LARGE VOLUME - LONG DISTANCE FRESH WATER TRANSFERRAL AS AN ALTERNATE

TO DESALINATION, Hudson Inst., Croton-on-Hudson, N.Y. Economic Development Studies Section.

Basil Candela, Ronald Dagon, John Karlik, and Robert Panero.

Hudson Institute, Croton-on-Hudson, NY, 1968. 52 p, 22 tab, 6 fig. HI-923/2-P.

Descriptors: *Arid lands, *Southwest U.S., *Water transfer, Desalination, *Mississippi River, Costs, Economic feasibility, Aqueducts, Pumping plants, Reservoirs, Tunnels, Oklahoma, Texas, New Mexico, Arizona, Colorado River Basin, Dams, Water demand, Evaporation.
Identifiers: * Arkansas River.

A preliminary evaluation was made of the transfer of Mississippi and Arkansas River water from 800 to 1600 miles to the southwestern U.S. as an alternative to desalination. The system described would use about 10% of the Mississippi flow transferred by pumping stations, reservoirs, tunnels and aqueducts to Texas, Oklahoma, New Mexico, Arizona, and the lower Colorado River use areas. It is concluded that such water transfer could be done at a cost of 5 to 12 cents per thousand gallons. This at a cost of 5 to 12 cents per thousand gallons. This is substantially lower than estimated desalination costs of 20 to 30 cents per 1000 gallons plus costs of delivery. The arid areas of the Southwest could be dependably and permanently watered by a transfer system such as proposed for an investment of 5 to 12 billion dollars. The desirability of investing in such a large scale system would be dependent upon whether the Southwest could develop a demand for such a volume of water. (Crouse-Arizona) Arizona)

Field 06-WATER RESOURCES PLANNING

Group 6D-Water Demand

W70-03810

THE WATER-RESOURCE COMMUNICATIONS

GAP, William S. Foster.

The American City Vol LXXXIV, No 10, p 83-86. Oct 1969. 4 p, 9 ref.

Descriptors: *Water purification, *Economics, *Pollution, Aeration, Biological treatment, Government supports, Water supply, Water demand, Desalination, Piping, Water storage popula-tion, Management, Costs, Farm wastes, Measurement, Computers.

Identifiers: *Mechanical chemical, Agricultural pollution, Metering, Water reuse, Chemical pollu-

The author predicts a huge increase in the amount of water demand in urban areas based on popula-tion predictions. He considers various aspects of tion predictions. He considers various aspects of the prospective problem along with the economic, esthetic, and safety factors. The economic feasibili-ty of desalting sea water is discussed as well as the changes required in above ground storage, piping and metering practices. He stresses the necessity for improved water quality and describes some of the dangers of agricultural pollution. The article concludes with a discussion of the low initial but high operating costs of the mechanical-chemical water purification plants and the necessity of making the public aware of the problem. (Murphy-Rutgers) W70-03841

THE WATER SUPPLY SYSTEM UP TO A.D.

Manchester Business School (England). For primary bibliographic entry see Field 06C. W70-03842

6E. Water Law and Institutions

THE TIDELANDS CONTROVERSY AND LOUISIANA'S EXPERIENCE IN THE DISPUTE, J. Gremillion.

In: 1963 Tulane Tidelands Inst, p 77-105, Claitor's Book Store (1963) Baton Rouge, La.

criptors: *Louisiana, *Submerged Lands Act, *Tidal waters, *Continental shelf, Federal government, State governments, Coasts, Relative rights, Leases, Judicial decisions, Legislation, Legal aspects, High water mark, Low water mark, Oil fields, Boundary disputes, Gulf of Mexico, Califor-nia, Texas, Mississippi, Alabama, Florida, Treaties,

Identifiers: Tidal lands, Made lands.

This report by the Attorney General of Louisiana examines the history of the tidelands controversy up to May 15, 1962. The controversy is described up to May 15, 1962. The controversy is described in chronological sequence beginning with Senate Joint Resolution 208, 75th Congress 1st Sess, which although ultimately defeated, proposed to declare the bed of the sea within three miles of the shore of the United States to be property of the federal government. Both the litigation and legislation involved in the controversy are outlined with emphasis upon the Submerged Land Act of 1953. The report discusses: (1) federal leasing in the contested areas; (2) the placing of lease revenue in escrow by the United States and Louisiana; (3) made-land problems; (4) the effect of the Geneva Convention; (5) equal boundary legislation; and (6) the work of the 1962 Coast Line Committee. A glossary defines: tidelands, littoral state, lands beneath navigable waters, made-lands, coast line, beneath navigable waters, made-lands, coast line, boundaries, continental shelf, inherent sovereignty, paramount rights, baseline, and marine league. Reference is also made to the Norwegian Fisheries Case and to the Outer Continental Shelf Lands Act. Emphasis is placed upon the Louisiana situation. (Marsee-Florida)
W70-03688

SHAPING THE LAW OF WEATHER CON-

TROL, V. Ball.

Yale L J, Vol 58, No 2, p 213-244, Jan 1949. 32 p, 131 ref.

Descriptors: *Weather modification, *Legal aspects, *Political aspects, *Artificial precipita-tion, Cloud seeding, Climatology, Cloud physics, Conservation, Droughts, Federal government, State governments, Meteorology, Rain, Storms, Weather, Water shortage, Water supply, Weather forecasting, Flood control, Hurricanes, Hail, Lightening, Snowfall.

In analyzing the legal problems involved in artificial modification or control of the weather, this article discusses: (1) scientific advances in weather modification and their possible application; (2) storm modification including thunderstorms, hail, lightening, snowstorms and hurricanes; (3) water storage and drought alleviation; (4) prevention of freezing rain, sleet and glaze; (5) cloud and fog dispersal; (6) forest fires; (7) flood control; (8) military uses; (9) classes of legal disputes arising from weather modification; (10) criminal prosecution and similar statutory penalties; (11) tort liability; (12) discovery, proof and causation; (13) government conduct in the area; (14) security restrictions on weather experiments; (15) claims of property in weather phenomena; and (16) water rights. A program for action for solution of the legal problems relating to weather control and experimentation deals with: (1) temporary prevention of irresponsible activity; (2) government-sponsored activity; (3) government authority; (4) government liability and waiver of immunity; and (5) authority to indemnify government contractors for losses incurred by liability for damages. (Marsee-Florida) W70-03719

MINERAL RIGHTS VERSUS WATER RIGHTS.

Edward W. Clyde.
Nat Res Lawyer, Vol 2, No 4, p 299-328, Nov 1969. 30 p, 99 ref.

Descriptors: *Water management (Applied), *U-Descriptors: *Water management (Applied), *U-tah, *Mineralogy, *Preferences (Water rights), Prior appropriation, Dewatering, Mine water, Mine drainage, Mining, Coal mines, Mineral industry, Strip mines, Land subsidence, Prescriptive rights, Hydrologie cycle, Irrigation, Land subsidence, Water rights, Water allocation (Policy), Natural flow doctrine, Competing uses, Equitable apportionment, Overlying proprietor, Water reuse, Water salvage, Water pollution, Legal aspects, Oil, Natural cas. Natural gas.

In a time of increasing technological progress, the law must change to meet the needs of the evolving society. Today, increased individual use by industry of our natural resources is prescribed by the law that has grown out of the needs of our society. The individual must bend to the will, i.e. the law, of the majority. In the area of water use and the mining of coal, oil, and minerals, a balance between the dividual's use and the needs of the general public is necessary. An extensive review of case law in the western United States examines the law of the country which balances the rights of the individual versus the individual, the individual versus industry and the individual versus society. The major emphasis is on the mining industry and its use of percolating, ground and surface waters termed therein as the private right to develop land versus private water rights. The right of eminent domain to acquire rights of way to put water to beneficial use is examined. Other problems in the general area of competing uses of water are discussed. (Barnett-Florida)

REGULATION OF FERRY OPERATIONS. Ohio Rev Code Ann secs 4583.01 thru 4583.17 Descriptors: *Ohio, *Boats, *Boating regulations, *Transportation, Legal aspects, Streams, Navigation, Regulation, Navigable waters, Riparian rights, Riparian land, Legislation, State governments, Rates, Permits, Control, Standards, Operation.

Licenses must be procured by individuals who desire to operate and maintain ferries within the state. Persons owning land on both sides of a stream at the proposed location of a ferry have the exclusive right to operate the ferry at that site. Maximum rates for transporting persons and property by ferry are established by the court. Minimum daily service requirements for ferry operation are set forth. Penalties are provided for ferrymen who fail to meet these operation recommendations of the service requirements. ments or who charge excessive rates. (Casey-Florida) W70-03739

DUTIES OF DIRECTOR OF PUBLIC WORKS REGARDING SWAMP LANDS

Ohio Rev Code Ann sec 155.06 (Page 1969).

Descriptors: *Ohio, *Swamps, *Land tenure, *Real property, Legislation, Wetlands, Surveys, Mapping, State governments, Administrative agencies, Federal government, Legal aspects, Patents, State jurisdiction, Marshes, Maps, Proprietary power.

The Director of Public Works is required to obtain scrip and patents for all lands belonging to the state. The Director must make a record of all swamp, marsh, and overflow lands to which the state has or should have title and attempt to perfect title to such lands which might belong to the state. He is directed to collect for the state all money due from the federal government for lands sold or purchased within the state by the United States or its agents. The Director is to survey all state lands, have plats made and file them with the state auditor, and record the title to such lands in the proper county. The Governor may impose additional du-ties upon the Director concerning claims against the federal government or lands belonging to the state. (Schram-Florida) W70-03740

COUNTY FISHING LAKES AND RECREATION

Tenn Code Ann secs 11-801 thru 11-803 (1956).

Descriptors: *Tennessee, *Recreation, *Lakes, *Recreation facilities, Legislation, Eminent domain, Condemnation, Compensation, Local governments, Construction, Real property, Fishing, Sport fishing, Legal aspects, Wildlife management, Public lands, Public benefits, Damages, Assessments, Payment, Resource development, Area redevelopment.

Any county court may acquire by gift, purchase, or condemnation any natural lakes or lands suitable for the county may hold fee simple title to the land and may acquire it under the laws of eminent domain. Before any natural lake or lands adapted for the construction of lakes is condemned, an engineer's plat must be made and filed in the county register. After such filing the filed in the county register. After such filing the county court may acquire the property which shall be dedicated to the public use under the game and fish laws of the state. All compensation and damages for property acquired for these purposes shall be a direct charge upon the general county fund and shall be paid when properly assessed under the laws of eminent domain. (Schram-Florida) Florida) W70-03745

BOUNDARIES (STATE). Tenn Code Ann secs 4-201 thru 4-207 (1956).

Descriptors: *Tennessee, *Boundaries (Property), *Mississippi River, *Political aspects, State jurisdiction, State governments, Rivers, Tennessee River, Islands, Legal aspects, Interstate rivers.

Water Law and Institutions-Group 6E

The boundaries of the state of Tennessee are detailed. The western boundary is the middle of the stream of the Mississippi River. (Schram-Florida) W70-03747

POWERS UNDER CITY MANAGER CHARTER. Tenn Code Ann sec 6-1901 (1956).

Descriptors: *Tennessee, *Cities, *Public utilities, *Waste disposal, Legislation, Legal aspects, Financing, Taxes, Condemnation, Regulation, Construction, Bridges, Maintenance, Sewers, Drains, Drainage, Sewage, Streams, Rivers, Structures, Utilities, Public health, Surface drainage, Docks, Permits, Operation and maintenance, Pollution sources.

Identifiers: *Improvements, Viaducts, Franchises, Land acquisition.

Every city will have the following powers relating to water law: (1) to collect taxes for all city purposes; (2) to finance necessary structures and improvements; (3) to acquire by condemnation or otherwise and hold any interest in property; (4) to acquire, construct, maintain, operate or lease any public utility; (5) to grant franchises for public utilities and public services to be furnished the city; (6) to prescribe reasonable regulations governing the maintenance, operation and extension of public utilities; (7) to establish, alter, construct, and maintain public docks, bridges, viaducts, sewers and drains and to regulate the use thereof; (8) to provide for the drainage of all public places; (9) to acquire, construct, regulate and maintain bridges, sewers, structures, works and improvements; (10) to collect and dispose of drainage, sewage, offal, ashes, garbage and refuse by discharging the same into streams and rivers or otherwise, or to license and regulate such collection and disposal; and (11) to define, prohibit, abate, prevent and regulate all things detrimental to the health, comfort, safety or welfare of the citizens. (Keith-Florida)

BRIDGES.

Mo Ann Stat secs 234.100 thru 234.200 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Bridges, *Right-of-way, *Financing, Administrative agencies, Government finance, Legislation, Legal aspects, Navigable waters, Streams, Condemnation, Eminent domain, Projects, Local governments, Construction, Maintenance, Assessments, Highways, Civil engineering, Bridge construction.

Any Missouri city adjoining a navigable stream and separated by such stream from a Missouri county and the county court of such county may unite in purchasing a right-of-way over any bridge crossing such stream. The city and county may unite for construction of a proposed bridge across a navigable stream. The financing and assessment of costs incurred by purchasing such rights-of-way are regulated. Condemnation proceedings to secure a public access to such bridge are governed. A toll bridge connecting two counties is permitted when the bridge cannot be built, reconstructed, or maintained at county expense due to the lack of funds or power to raise the funds. The building or reconstruction of a toll bridge to be located wholly within one county is regulated. A toll bridge is part of the Missouri highway system. The Missouri State Highway Commission is authorized to join with the state highway commission of another state in contracting for a toll bridge to connect the two states. (Powell-Florida)

BRIDGES.

Mo Ann Stat secs 234.210 thru 234.350 (1952).

Descriptors: *Missouri, *Bridges, *Local governments, *Bridge construction, Legislation, Easements, Right-of-way, Condemnation, Financing, Real property, Eminent domain, Highways, Ad-

ministrative agencies, Supervisory control (Power), Construction costs, Loans, Interest, Assessments, Costs, Maintenance costs, Government finance, Tunnels, Tunnel construction. Identifiers: *Toll bridges.

Any political or civil subdivision of the state may acquire, construct, and operate toll bridges, within or adjacent to its jurisdiction, and over any waters in or forming the boundary of the state. These state agencies may acquire, by purchase or eminent domain, all necessary land, rights-of-way, easements, and materials for constructing, improving, or maintaining toll bridges. The State Highway Commission, when in the best interests of the state, may contribute up to thirty percent of the construction costs of these bridges and may maintain such bridges as a part of the state highway system. Qualifications and procedures for financing the toll bridges are detailed. Cities operating under special charter are authorized to acquire or construct bridges and viaducts and maintain them for the public use. For this purpose lands, easements, rights-of-way, and other property rights may be purchased or acquired by condemnation. First class cities and cities of over one hundred thousand population may construct bridges and tunnels for public use. (Schram-Florida)

TENNESSEE-MISSOURI BRIDGE COMMISSION.

Mo Ann Stat secs 234.360 thru 234.420 (1952).

Descriptors: *Missouri, *Bridge construction, *Interstate compacts, *Interstate commissions, Bridges, Tennessee, Legislation, Financing, Planning, Maintenance, Repairing, Compensation, Condemnation, Supervisory control (Power), Cost repayment, Real property, Maintenance costs, Construction costs, Costs, Bridge construction, Mississippi River, Administrative agencies, Easements.

Identifiers: *Tolls, Toll bridges, Ferries.

The Governor, with the advice and consent of the Senate, will appoint three commissioners to enter into a compact with Tennessee. The Tennessee-Missouri Bridge Commission is created with the following powers and duties: (1) to plan, construct, maintain and operate a bridge across the Mississippi River at or near Caruthersville, Missouri; (2) to purchase, maintain and operate any or all ferries across the Mississippi River within twenty-five miles of the bridge; (3) to contract and acquire property by condemnation or otherwise; (4) to issue bonds for the payment of the costs of the bridge, ferries, and necessary property on the security of the revenues derived from the operation of the bridge and ferries; (5) to establish and charge tolls for transit over such bridge and ferries; and (6) to perform all other necessary and incidental functions. Toll rates will be charged to provide funds sufficient to pay for maintenance, repairs, and operation of the bridge, and to pay the principal and interest on outstanding bonds. The administrative composition of the Commission is provided for. Upon the retirement of all bonds and the conveyance of title to the bridge to the states of Missouri and Tennessee, the Commission will be dissolved. (Schram-Florida)

MISSOURI--ILLINOIS BRIDGE COMMISSION.

Mo Ann Stat secs 234.500 thru 234.570 (Supp 1970).

Descriptors: *Missouri, *Interstate commissions, *Supervisory control (Power), *Bridge construction, Administrative agencies, Federal government, State governments, Structures, Financing, Missispipi River, Real property, Condemnation, Easements, Legislation, Regulation, Planning, Illinois, Operation and maintenance, Interstate compacts, Interstate rivers, Bridges.

Identifiers: Penalties (Civil), Ferries, Tolls.

The states of Missouri and Illinois establish by compact an Illinois-Missouri Bridge Commission to plan, construct and maintain a bridge across the Mississippi River between the two states. The Commission may purchase, maintain, and operate all ferries within fifteen miles of the site selected for the bridge. It may acquire real property necessary for construction of the bridge. It may issue bonds to finance the bridge and charge tolls for transit over the bridge. When the bonds have been retired, each state shall own that part of the bridge within its borders, and thereafter the bridge shall be toll free. The organization of the Commission is described. The compact is to be submitted to the United States Congress for approval. The Commission shall be dissolved upon retirement of all bonds and conveyance of title to the bridge to the two states. (Duss-Florida) W70-03753

MISSOURI-ILLINOIS-JEFFERSON-MONROE BRIDGE COMMISSION.

Mo Ann Stat secs 234.580 thru 234.650 (Supp 1970).

Descriptors: *Missouri, *Interstate compacts, *Bridge construction, *Interstate commissions, Illinois, Mississippi River, Interstate rivers, Construction, Maintenance, Planning, Financing, Bridges, Costs, Contracts, Condemnation, Structures, Regulation, Easements, Administrative agencies, Legislation, Legal aspects, Supervisory control (Power), Operation and maintenance. Identifiers: Ferries, Tolls, Bonds.

The Governor, with the advice and consent of the Senate, will appoint three commissioners to enter into a compact with Illinois. The Missouri-Illinois-Jefferson-Monroe Bridge Commission is created with following powers and duties: (1) to plan, construct, maintain and operate a bridge across the Mississippi River at or near Crystal City, Missouri; (2) to purchase, maintain, and operate any or all ferries across the Mississippi River within twenty-five miles of the bridge; (3) to contract and acquire property by condemnation or otherwise; (4) to issue bonds for the payment of the costs of the bridge, ferries and necessary property on the security of the revenues derived from the operation of the bridge and ferries; (5) to establish and charge tolls for transit over such bridge and ferries; and (6) to perform all other necessary and incidental functions. Toll rates will be charged to provide funds sufficient to pay for maintenance, repairs and operation of the bridge and to pay the principal and interest on outstanding bonds. administrative composition of the Commission is provided for. Upon the retirement of all bonds and the conveyance of title to the bridge to the states of Missouri and Illinois, the Commission will be dissolved. (Keith-Florida) W70-03754

FERRIES AND WHARVES.

Mo Ann Stat secs 237.010 thru 237.240 (1952).

Descriptors: *Missouri, *Docks, *Boats, *Permits, Boating regulations, Rates, Legislation, Boating, Cities, Local governments, Ships, Legal aspects, Transportation, Leases. Identifiers: *Ferries, *Licenses.

A license is required in order to keep a commercial ferry. Procedures for the application, issuance, continuation and revocation of ferry licenses are provided. Ferriage rates are fixed by the county court. Any city, town, or other municipal corporation may lease to any owner of boats, steamboats or vessels any portion of the city or town wharf or landing for the purpose of maintaining wharf boats to accommodate steamboats and merchants in the reception and discharge of freights. (Powell-Florida)

Field 06-WATER RESOURCES PLANNING

Group 6E-Water Law and Institutions

ISLANDS AND ABANDONED RIVER BEDS.

Mo Ann Stat secs 241.290 thru 241.340 (1952).

Descriptors: *Missouri, *Islands, *Beds, *Ownership of beds, Dry beds, Local governments, Legislation, Lake beds, River beds, Navigable waters, Streambeds, Meanders, Compensation, Boundaries (Property), Surveys, Land reclamation, Public lands, Swamps, Mapping, Real property, Overflow, Federal reclamation law, Legal aspects, Reclamation, Land forming. Identifiers: Counties.

Unless otherwise appropriated, all state lands formed by the recession of waters from old lake and river beds or by the formation of islands in the navigable waters of the state are transferred to the respective counties in which they are located. These lands are to be held for school purposes. All state lands hereafter found in the above manner shall also be transferred to the counties for school purposes. All counties in which such lands are situated may survey and sell them in the same manner as reclaimed swamp lands. The proceeds of such sales shall become a part of the swamp land school funds of the counties. In surveying these lands, the surveyor shall: (1) connect the survey with some United States survey corner; (2) meander islands and such beds as may abut on a navigable river or lake; and (3) subdivide such lands into section and quarter sections. (Schram-Florida)

TOWN OF PALM BEACH V CARTER (PROHIBITION OF SURFING WITHIN TOWN LIMITS FOUND CONSTITUTIONAL).

229 So 2d 3-5 (4th DCA Fla 1969).

Descriptors: *Recreation, *Surf-boarding, *Water sports, *Beaches, Attitudes, Swimming, Public health, Safety, Local governments, Surf, Shores, Legislation, Judicial decisions, Legal aspects, Cities Motivation.

The defendant was convicted in municipal court for violating an ordinance prohibiting operation of a surfboard adjacent to any beach within the town limits. The circuit court reversed the conviction, declaring the ordinance to be an unconstitutional exercise of the municipality's police power. The district court reinstated the municipal court's conviction. The district court stated that the constitutionality of the ordinance depended upon whether or not it had a natural relation to the health, morals, safety, or general welfare of the public. Finding that the ordinance was designed to make the public beaches safe and was prompted by the town's decision that surfing had become hazardous to bathers, the court concluded that the ordinance was a reasonable exercise of the police power. (Schram-Florida)

UNITED STATES V 967.905 ACRES OF LAND (CONDEMNEES DEMAND COMPENSATION FOR BARGES ON LAKE SURROUNDED BY CONDEMNED LAND).
305 F Supp 83-93 (D Minn 1969).

Descriptors: *Minnesota, *Eminent domain, *Condemnation, *Compensation, State governments, Federal government, Federal jurisdiction, Federal reservations, Public lands, Real property, Condemnation value, Fishing, Lake shores, Lakes, Legislation, Foreign countries, Conservation, Judicial decisions, Legal aspects, Boats, State jurisdiction. Identifiers: Canada.

The United States took certain land by eminent domain to establish a wilderness area. The condemnees contended that they should be compensated for three cabin barges which had been used in the operation of condemnees' fishing business and which could not be practically removed from the

condemned land. The district court held that the condemnees were entitled to compensation for the barges. Applying Minnesota's law of eminent domain, the court found that personal property attached to the land is considered a fixture and therefore a part of the land. The barges were found to be adapted solely for condemnees' fishing operation and not practically removable from the lake bordering the condemned all the land surrounding the lake rendering the barges inaccessible, and because the peculiar nature of the barges made abandonment necessary, condemnation of the land constituted a substantial, direct, and immediate taking of the barges. (Schram-Florida)

FORDS AND PUBLIC BRIDGES (CLEARING OF FORDS AND BUILDING OF BRIDGES).

Tenn Code Ann secs 54-1101, 54-1103, 54-1107, 54-1109, 54-1113, 54-1125, 54-1128 (1968).

Descriptors: *Tennessee, *Bridges, *Bridge construction, *Local governments, Rivers, Streams, Swamps, Cost allocation, Roads, Timber, Legislation, Legal aspects, Construction costs. Identifiers: *County courts, *Fords.

County courts may clear out fords of rivers where public roads cross. Magistrates of each district shall report to the county court which fords they think should be cleared. Methods of clearing fords are described. Two counties divided by a river may agree to jointly construct and pay for a bridge over such river. County courts have the power to construct bridges over streams or rivers running through the counties, provided such bridges shall be located near a public highway. County courts may construct free bridges within the corporate limits of county seats. Joint county and city bridges are authorized. (Duss-Florida)

ESTABLISHMENT OF FREE FERRIES.

Tenn Code Ann secs 54-1201 thru 54-1203, 54-1206 (1968).

Descriptors: *Tennessee, *Streams, *Public benefits, *Condemnation, Navigable rivers, Boats, Rivers, Navigable waters, Banks, Roads, Regulation, Joint costs, Financing, Legislation, Cost allocation, Non-navigable waters, Operation and maintenance, Road construction, Legal aspects. Identifiers: *Ferries, Landings.

All counties may, through the county court, establish, equip, and operate free public ferries over any streams running through or bounding such counties. Counties have the power to condemn land for approaches to the ferries and for landings at the river banks. Such condemnation shall conform to the condemnation procedures for county roads. Two or more counties may cooperate in establishing ferries across navigable or unnavigable streams bordering such counties and share the costs of the construction among themselves. County courts have the power to appropriate money for the establishment of ferries and ferry roads on any navigable stream and for the construction of necessary roads across river bottom lands and up and down river banks to such ferries. (Duss-Florida) W70-03774

HIGHWAYS, BRIDGES AND FERRIES (PRIVATE AND LOCAL IMPROVEMENTS).

Tenn Code Ann secs 54-1701 thru 54-1732 (1968).

Descriptors: *Tennessee, *Bridges, *Boats, *Bridge construction, Legal aspects, Civil engineering, Mill dams, Legislation, Engineering structures, Riparian rights, Streams, Navigable waters, Construction, Maintenance, Banks, Bank

erosion, Riparian land, Bank stabilization, Sedimentation, Sediment control. Identifiers: *Ferry, Ferry boats, Obstruction to navigation.

The county court authorizes private and local improvements on toll bridges, causeways across bottoms, fish traps, milldams, and ferries. A bridge, milldam, fish trap or other improvement obstructing a navigable stream is prohibited. A petitioner in order to construct a toll bridge, milldam, or other obstruction across any river or watercourse must own or have consent of the owner of land on both sides of the watercourse. Provisions cover proposed improvements on and construction of toll bridges across a stream dividing counties. The county court authorizes the erection of ferries. Where banks are owned by different persons, each owner may keep a ferry and must repair both banks. Banks or approaches to public ferries on all streams must be graded and macadamized as prescribed. After any high water the owner or keeper of a ferry must wash or shovel sediment back with the fall of the stream. Ferryboat conkeep a ferry or toll bridge must be bonded. (Powell-Florida) W70-03775

FISH AND GAME.

Tenn Code Ann secs 51-201 thru 51-235 (1966), as amended, (Supp 1969), secs 51-236, 51-237 (Supp 1969).

Descriptors: *Tennessee, *Fishing, *Permits, *Fish conservation, Fish management, Legislation, Legal aspects, Regulation, Fishing gear, Baits, Sport fishing, Commercial fishing, Recreation, Water utilization, Fish, Brook trout, Brown trout, Rainbow trout, Administrative agencies, Minnows, Fish stocking, Ponds, Lakes, Reservoirs, Fisheries, Fish hatcheries.

Taking fish without a license is illegal. Children under sixteen and military personnel on furlough are not required to purchase a sport fishing license. License exemptions are extended to persons fishing in their resident county and to owners and tenants of farm lands and their dependent children. Certain persons are entitled to a free sport fishing license. A commercial fisherman is any person who takes or who aids and assists another in taking fish or other aquatic life from Tennessee waters for pay or the purpose of sale, barter, or exchange. Wholesale fish dealers are defined and regulated. Minnow bait dealers are regulated. Persons operating a commercial or private lake, pond, or reservoir must be licensed. Fish stocking is a Tennessee state prerogative. Persons taking or attempting to take brook, rainbow, or brown trout must have a trout license in addition to the fishing license. A catchout pond is an artificially impounded body of water in which artificially propagated fish or rough fish are held available for anglers and purchasers. Fish farming is the rearing of artificially propagated, non-bait fish for the purpose of sale. (Powell-Florida)

HUNTING AND FISHING REGULATIONS. Tenn Code Ann secs 51-401 thru 51-442 (1966), as amended, (Supp 1969).

Descriptors: *Tennessee, *Fishing, *Fish conservation, *Regulation, Legal aspects, Legislation, Administrative agencies, Suckers, Fish management, Bait fishing, Commercial fishing, Sport fishing, Baits, Fish, Fishing gear, Recreation, Sport fish, Fish stocking, Freshwater fish, Lakes, Streams, Nets, Minnows, Aquatic animals, Electrofishing. Identifiers: *Game fish, *Grabbling.

Fishing is lawful in any lake or stream when the supply of fish adequately allows their taking without danger of extinction or depletion. The state Game and Fish Commission sets the creel, size, and

bag limits, and manner and means of taking fish during the open season. Open season on private lakes is set by the operator. Game fish are defined by species and common names. The sale and taking for sale of game fish is regulated. Fishing in Reelfoot Lake is regulated. Shooting into Tennessee waters for the purpose of taking fish is illegal. Seines are forbidden except in private waters, in waters which are replenished by annual or periodic overflows from listed waters or other waters designated by the Commission. Grabbling, the taking of fish by hand, is prohibited. The use of nets, seines, snag lines, drag lines, grab hooks, baskets, or any other form of fishing is regulated in designated areas. The taking, transporting, and sale of minnows for bait is controlled. The taking of fish, mussels, and other aquatic animal life other than game fish is required. The use of dynamite, electricity, explosives, chemicals, lime or poison in taking fish is prohibited. There is a restricted season on all species of sucker and red horse fish.
(Powell-Florida) W70-03777

FISH AND GAME (ENFORCEMENT OF GAME AND FISH LAWS).

Tenn Code Ann secs 51-701 thru 51-717 (1966).

Descriptors: *Tennessee, *Regulation, aspects, *Wildlife conservation, Legislation, State aspects, Whithe Conservation, Eggislation, State governments, Administrative agencies, Administra-tion, Trapping, Hunting, Fishing, Judicial deci-sions, Wildlife, Frogs, Game birds, Habitat im-provement, Wildlife management, Permits, Equipment.

Identifiers: Penalties (Criminal), Confiscation.

The Fish and Game Law provides administrative, procedural and judicial guidelines for the enforcement of its mandates. The law is enforced by the officers of the Game and Fish Commission. Penalties for violations are prescribed. Violators will be prosecuted before a justice of the peace and if found guilty will have a right of appeal to the circuit court of the county. A mistake of fact by the violator shall be no defense. Game taken illegally and illegal equipment shall be impounded and upon conviction declared contraband. Contraband shall be sold at public sale, the proceeds of which shall go to the Fish and Game Fund. All property used in violation of sections 51-425 to 51-427 of this act is declared contraband, and is subject to seizure and public sale. Claimants to such property must adhere to procedural guidelines herein requiring a hearing, posting of bond and, upon adverse ruling by the Commission Director, a review by the circuit court. Remedies provided herein are exclusionary to all others. A monthly report of all fines and for-feitures must be filed by the circuit court. The grand juries of each county shall have inquisitional powers into offenses alleged under this act. (Barnett-Florida) W70-03778

LIABILITY OF LANDOWNER TO PERSONS USING LAND.

Tenn Code Ann secs 51-801 thru 51-805 (1966).

Descriptors: *Tennessee, *Recreation, *Land use, Descriptors: *lennessee, *Recreation, *Land use, *Land tenure, Legislation, State governments, Regulation, Boating, Camping, Swimming, Water sports, Access routes, Hunting, Reasonable use, Camp sites, Permits, Real property, Channels, Legal aspects, Relative rights, Remedies, Damages.

A landowner is defined as the legal title holder, lessee, or occupant of any land or premises. 'Land' or 'premises' includes all real property, waters, private ways, and any timber or structures located thereon. The landowner has no duty of care to keep his land safe for entry or use by others for hunting, fishing, camping and like activities, nor is he required to give warning of hazardous conditions existing on such land. In granting permission to use his land, a landowner extends no assurances that the land is safe or that he will assume responsibility for any injury incurred. A person given permission to use the land does not acquire the status of invitee by virtue of such permission. Willful or malicious failure by the landowner to guard or warn against a dan-gerous condition will render him liable for injury notwithstanding this section. The landowner may be liable for damages if the injury is incurred by one who pays consideration for permission to engage in hunting, fishing, or sightseeing, or if one granted permission to use the land by the landowner causes injury to a third party on such land. (Barnett-Florida)

WISCONSIN FLOOD CONTROL.

For primary bibliographic entry see Field 04A. W70-03802

OCEAN MINERALS AND THE LAW,

Hollis M. Dole.

Nat Res Lawyer, Vol 2, No 4, p 352-359, Nov 1969.8 p.

Descriptors: *Mining, *Oceans, *Exploitation, *Placer mining, Legal aspects, Federal jurisdiction, Exploration, Oceanography, Geology, Marine geology, Continental shelf, Oil, Natural resources, Oil fields, Oil industry, State jurisdiction, State governments, Water resources development, Beds, Leases, Mineral industry.

Improved technology and depletion of mineral resources located on land have refocused attention on the seas as sources of minerals. Ocean minerals include materials dissolved or suspended in water, materials in rocks beneath the ocean, and metallic mineral deposits concentrated by oceanographic processes. The latter raise the greatest legal problems concerning operation of extraction facilities and leasing of mineral rights. The development of near-shore placers, which are accumulations of heavy minerals caused by water movements, will lead to development of offshore mineral resources. Laws must be enacted to allow near-shore placer mining or no further technological development will be possible. Most states have ignored the problem, relying on existing onshore mining legisla-tion. This legislation is now inadequate because it applies to outdated methods of ocean floor mining. The Coastal States conference on a Multiple Use Approach to Offshore Mining Law discussed relevant legislation, but its findings are not yet published. Under the Outer Continental Shelf Lands Act the federal government is authorized to lease mineral rights in the ocean bottom. This authority should be exercised in a manner designed to encourage development of placer mining. (Dye-Florida) W70-03822

WASTEWATER RATES **SERVICE** CHARGES IN GREAT BRITAIN,

West Hertfordshire Main Drainage Authority,

West Heritotishire Main Brainage Authority, Rickmansworth (England). Richard Wood. Journal Water Pollution Control Federation, Vol 41, No 12, p 1987-2001, Dec 1969. 14 p, 3 fig, 4 tab, 14 ref.

Descriptors: *Waste treatment, *Assessments, *Rates, *Pricing, *Taxes, Sewers, Cities, Costs, Prices, Economics, Water rates, Value, Industrial wastes, Water management (Applied).
Identifiers: *Great Britain, Service charges, Sewer

charges, London.

Local government services in Great Britain are financed by levying rates on property owners. Local communities bear the full costs of wastewater treatment. Assessments of the rateable value of each property are based on the theoretical rent of the property. Wastewater treatment plants are themselves rateable, but sewers and pumping sta-tions are not. Industrial waste charges are related to the costs of treating domestic wastewaters and are

from formulae set volume/strength/solids basis. These formulae vary with attempts to assess the 'treatability' of an industrial waste. (Knapp-USGS) W70-03875

GRAYSON V COMM'RS OF BOSSIER LEVEE DISTRICT (COMPENSATION FOR LAN-DOWNERS FOR LEVEE DISTRICT DAMAGES).

229 So 2d 139-147 (2d Cir La 1969).

Descriptors: *Louisiana, *Judicial decisions, *Eminent domain, *Compensation, Levees, Drainage, Drainage districts, Riparian land, Flood protection, Channels, Channel improvement, Legislation, Navigable rivers, Severance, Flood control, Real property, Legal aspects, Condemna-tion, Damages, Bank stability, Dredging, Adminis-trative agencies, Swamps, Bayous. Identifiers: *Levee districts.

Plaintiff landowners brought an action against the Levee Board for damages resulting from the en-largement of a drainage channel. After receiving a judgment for one-half of the value of their land occupied by the Levee District, the plaintiffs appealed, complaining of an inadequate award of damages. The main issue on appeal was the nature of the plaintiffs' land. The defendants claimed that it was riparian. According to a constitutional provision compensation should be limited to the assessed value of the land. The court held that for the land to be riparian, it must have fronted on a navigable river when the land was first separated from the sovereign. Finding that the land in question was not riparian when separated from the public domain, the court held that the constitutional limitation was not applicable. The fact that the plaintiffs also owned another tract which was riparian was held to be immaterial. In addition to damages to the land, the court held that the plaintiffs were entitled to recover for the destruction of pecan trees on their land as well as for their expenses for spreading the spoil dirt that was piled on their land by the Levee District. (Schram-Florida) W70-03903

LEGAL ACTIONS RELATING TO WATER-

Ohio Rev Code Ann secs 4585.01 thru 4585.15 (Page 1965).

Descriptors: *Ohio, *Boats, *Damages, Legislation, Regulation, Contracts, Transportation, Bodies of water, Docks, Admiralty, Navigation, Construction, Legal aspects, Navigable waters, Remedies. Identifiers: Penalties (Criminal).

Watercraft operating within the state are liable for injuries caused to persons or property by the watercraft, or by the captain or his agents. Such liability constitutes a lien on the watercraft. Liability may also attach for debts contracted for construction or maintenance of the craft. Claimants in any action for debt may proceed against the owner of the watercraft, the master who contracted the debt, or against the watercraft itself. It is unlawful to injure or destroy a watercraft of another. Criminal penalties for violations of the statute are provided. (Casey-Florida) W70-03915

NAVIGATION (ERECTION OF AIDS TO **NAVIGATION).**

Ohio Rev Code Ann secs 4581.01 thru 4581.12 (Page 1965).

Descriptors: *Ohio, *Buoys, *Navigation, *Ohio River, Legislation, Legal aspects, Navigable waters, Transportation, Rivers, Lakes, Canals, Harbors, Ships, Boats, Recreation, Beaches, Swimming, Docks, Regulation, Permits, Coasts. Identifiers: *Navigational aids, *Licenses.

Field 06-WATER RESOURCES PLANNING

Group 6E-Water Law and Institutions

Anyone interested in the navigation of a navigable water may erect and maintain on such waters buoys, lamps, or lanterns to facilitate navigation or buoys, tamps, of failtering to factinate lawgation of to protect bathing areas. Watercraft are prohibited from entering these marked areas except in an emergency. Wharf boat owners on the Ohio River must remain open at all hours to accomodate travelers and handle freight. Licenses are required for those peddling stock in watercraft or intending to reside on a watercraft. (Casey-Florida) W70-03916

WATER ADMINISTRATION - A SUGGESTED INSTITUTIONAL MODEL,

Clayton K. Yeutter. University of Nebraska, Dept Agricultural Economics Rep No 46, p 1-30, Dec 1968. 30 p, 54

Descriptors: *Planning, *Water resources development, *Administration, *Water allocation (Policy), Future planning, Creativity, Governments, Administrative agencies, Marketing, Multiple-purpose projects, Research and development, Water districts, Hydrologic aspects, Model studies, Theoretical analysis, Water rights, Local governments, Water distribution (Policy), Competing

If water law is to be effective, it must be preventive and not just curative. The author acknowledges the need for general guidelines for preventive water law and provides an institutional model designed to furnish these guidelines. At the top of the model is a Water Resources Board which would develop a comprehensive plan for the state, make broad pol-icy decisions, deal with state-wide water law problems, and coordinate local activities. Local orproblems, and coordinate local activities. Local organizations, such as streamflow, groundwater, and reservoir districts would try to make water rights as measurable and transferable as possible. This model is designed to be an economically middle of the road program combining both free market allocation and agency water allocation. This means that as far as possible the free market would determine water allocation in proportion to the demanding interests. However, those interests not capable of expressing their demands in the market place. of expressing their demands in the market place would be protected by the agencies. The goal is to protect all interests through private and public regulation and to maintain a program sufficiently flexible to meet changing interests and demands. (See also W70-04011 and W70-04012). (Darragh-Florida) W70-04010

WATER ADMINISTRATION - A SUGGESTED INSTITUTIONAL MODEL, Clayton K. Yeutter. University of Nebraska, Dep Agricultural Economics Rep No 46, p 2-6, Dec 1968. 5 p.

Descriptors: *Planning, *Water resources development, *Administration, *Water allocation (Policy), Future planning, Creativity, Governments, Administrative agencies, Marketing, Multiple purpose projects, Research and development, Water districts, Hydrologic aspects, Model studies, Theoretical analysis, Water rights, Local governments, Water distribution (Policy), Competing

The institutional model presented here exemplifies a 'middle of the road' political-economic-administrative philosophy. It is designed to provide a system by which the concepts of market allocation and agency allocation for water use and planning can be combined so as to work effectively together. The intent of such a model is to demonstrate that the two concepts are not necessarily mutually exclusive. Here the market place will be allowed to clusive. Here the market place will be allowed to control the allocation and use of the water supply, but there will be an agency framework available to resolve problems that the market place is not adequately equiped to handle. This model returns many of the transfer decisions to the users to be resolved by them in an atmosphere that will show which uses are most economically feasible. The trends of water planning toward more agency control have often resulted in non-economical distribution which should be avoided if possible. (See W70-04010). (Darragh-Florida) W70-04011

WATER ADMINISTRATION - A SUGGESTED INSTITUTIONAL MODEL,

Clayton K. Yeutter.
University of Nebraska, Dept Agricultural
Economics Rep No 46, p 7-17, Dec 1968. 11 p.

Descriptors: *Planning, *Water resources development, *Administration, *Water allocation (Policy), Streamflow, Ground water, Reservoirs, Fuicy), Streamilow, Ground water, Reservoirs, Future planning, Creativity, Governments, Administrative agencies, Marketing, Multiple purpose projects, Research and development, Water districts, Hydrologic aspects, Model studies, Theoretical analysis, Water rights, Local governments, Water distribution (Policy), Competing uses.

The institutional model presented is pyramidal in disign. At the peak is the Water Resources Board which is designed to promulgate and implement statewide water policy and planning. This function may necessitate sub-agencies under the Board to coordinate state and local activities, but the Board alone shall be responsible for state wide planning. At the base of the pyramid will be the local orginizations including perhaps streamflow, ground water, and reservoir districts. Local agencies can perform the task of local coordination of statewide projects. The local agency or district is also better able to communicate to the local residents the need for such planning and cooperation. (See W70-04010). (Darragh-Florida) W70-04012

FLORIDA'S LAKES (PROBLEMS IN A WATER PARADISE),

F. Maloney, and S. Plager. U Fla L Rev, Vol 13, No 1, p 1-82, Spring 1960, 82 p, 381 ref, append.

Descriptors: *Florida, *Lakes, *Water law, *Legal aspects, Boundaries (Property), Public rights, Riparian rights, Fishing, Swimming, Relative rights, Navigable waters, Non-navigable waters, Boating, Access routes, Recreation, Consumptive use, Nonconsumptive use, Meanders, Hunting, Piers, Landons, La fills, Ownership of beds, Legislation, Judicial decisions, State governments.
Identifiers: Rights of commercial users.

This is the third in a series of articles on Florida water law discussing: (1) navigability and public rights; (2) rights attributable to navigable lakes; and (3) rights attributable to non-navigable lakes. Headings one and two contain subdivisions. Sub-Headings one and two contain subdivisions. Subdivisions under the first heading deal with: (1) early common law developments; (2) American definitions of navigability; (3) the relationship between meandering and navigability; (4) Florida's trust doctrine; (5) possible statutory extension of navigability; (6) additional possibilities for the recognition of public rights; (7) possible use of Spanish civil law to bolster public rights; and (8) access to non-navigable lakes by invitation of riparians. Subdivisions under heading two deal with: (1) rights of riparian owners: (2) rights of the with: (1) rights of riparian owners; (2) rights of the public; and (3) rights of commercial users. As they relate to the subdivisions under heading two, the following are also discussed: (1) non-consumptive uses; (2) consumptive uses; (3) access and navigation; (4) fishing, swimming and hunting; (5) wharf and fill; (6) view; (7) lake levels; (8) passage along the shore; and (9) boating. An appendix sets forth the location, by county, township, and range, of Florida's meandered lakes. (See W70-04014 thru W70-04019). (Marsee-Florida)

FLORIDA'S LAKES (NAVIGABILITY AND PUBLIC RIGHTS), F. Maloney, and S. Plager.

U Fla L Rev. Vol 13, No 1, p 1-4, Spring 1960, 4 p, 16 ref, append.

Descriptors: *Florida, *Lakes, *Watercourses (Legal), *Public rights, Navigable waters, Ponds, Non-navigable waters, Legal aspects, State governments, Ownership of beds, Water law, Bodies of water, Standing waters, Surface waters, Bogs, Swamps, Lake beds, Navigation, Civil law, Federal government, Lakes.
Identifiers: English common law.

Lawyers and hydrologists tend to distinguish a natural lake or pond from a natural watercourse on the basis that water in a watercourse has a continuous motion, whereas in a lake or pond the water is substantially at rest. Although roughly accurate, this is an oversimplification. More accurately, a lake is essentially a close or self-contained system whereas watercourses are open systems serving as conveyors of surplus water from land to sea. The difference between a lake and pond is one of size. This article will attempt to trace the extent to which the law of lakes and ponds has turned on these differences. Florida's approach to navigability and public rights has been influenced both by common law developments and the Spanish civil law background of the state. Both will be examined. English common law granted or denied private and public rights in natural bodies of water on the basis of whether the water was navigable or non-navigable. The question of navigability was one of law, and although American courts adopted the concept of navigability, they have redefined the criteria. Different jurisdictions have developed varying definitions of navigability. (See W70-04013). (Marsee-Florida) on the basis of whether the water was navigable or

FLORIDA'S LAKES (TESTS OF NAVIGABILI-

TY), F. Maloney, and S. Plager. U Fla L Rev, Vol 13, No 1, p 4-15, Spring 1960. 11

Descriptors: *Florida, *Lakes, *Public rights, Pescriptors: *Florida, *Lakes, *Public rights,
*Navigable waters, Non-navigable waters, Legal
aspects, Judicial decisions, State governments,
Federal government, Lake beds, Navigation, Public
lands, Ownership of beds, Water law, Bodies of
water, Legislation, Surface waters, Recreation demand, Recreation. Identifiers: Trust doctrine.

The federal test of navigability uses the criterion of the commerical utility of the body of water in question; it is a test of navigability in fact and al-lows inclusion of artifically improved waterways. Florida differs by requiring waters to be navigable in their natural state but has to date applied a commercially oriented criterion similar to the federal one. Florida courts have not yet expressly decided one. Florida courts have not yet expressly decided whether navigability embraces navigation for purely recreational purposes. Immediately following the acquisition of Florida by the United States, federally employed surveyors meandered those lakes they judged navigable. However, due to the difficulty of meandering swampy shorelines, relatively few lakes were ultimately meandered. The fact that a lake was meandered is accepted by Florida courts as evidence of navigability, and fact that a lake was meandered is accepted by Florida courts as evidence of navigability and therefore of public ownership, but the failure to meander a lake has been held to not conclusively evidence that it is not navigable. Navigability in fact is again the test; therefore, non-meandered lakes may be available for public use. Florida has adopted the trust doctrine and takes the position that the state holds title to lands under navigable waters in trust for the people. (See W70-04013). (Marsee-Florida) W70-04015

FLORIDA'S LAKES (RIGHTS IN LAKES),

F. Maloney, and S. Plager. U Fla L Rev, Vol 13, No 1, p 15-22, Spring 1960. 7 p, 30 ref, append.

Descriptors: *Florida, *Lakes, *Public rights, *Recreation demand, Navigable waters, Nonnavigable waters, Legal aspects, Civil law, Judicial decisions, Legislation, State governments, Riparian land, Riparian rights, Riparian waters, Lake beds, Recreation, Navigation, Public lands, Ownership of beds, Water law, Bodies of water, Surface waters.

In addition to the possibility of a judicial broadening of the definition of navigability, Florida might also bolster public rights of recreation by: (1) statutorily extending the concept of navigability; (2) creating special development and water conservation districts; (3) establishing a dedication of an easement for public use in non-meandered lakes: (4) granting special tax treatment to riparians who permit the public to gain access to water over their lands; and (5) utilizing Spanish civil law. Spanish civil law, unlike common law, saw nothing inconcivil law, unlike common law, saw nothing inconsistent in the sovereign's conveying the bottoms of certain lakes to private individuals while at the same time preserving the right of the public to traverse the water. Because of the civil law background of Florida, the Florida courts might be willing to recognize these Spanish doctrines as aids in sustaining the recognition of public rights in public waters. (See W70-04013). (Marsee-Florida) W70-04016

FLORIDA'S LAKES (RIGHTS ATTRIBUTABLE TO NAVIGABLE LAKES),

F. Maloney, and S. Plager. U Fla L Rev, Vol 13, No 1, p 22-55, Spring 1960. 34 p, 165 ref, append.

Descriptors: *Florida, *Riparian rights, *Consumptive use, *Non-consumptive use, Riparian water, Public rights, Judicial decisions, Water rights, Navigation, Recreation, Withdrawal, Access routes, Fishing, Swimming, Hunting, Landfill, Water levels, Piers, Domestic water, Industrial water, Agriculture, Municipal water, Water supply, Lakes, High water mark.

In Florida, as in most Eastern jurisdictions, riparian rights are property. To be entitled to such rights, an owner must prove his ownership of the land to the high water mark. One question is the location of that mark. Riparian rights in a navigable lake can be considered under two headings: consumptive uses and non-consumptive uses. Non-consumptive used include access and navigation fishing used include access and navigation, fishing, swimming, hunting, wharf and fill, view, and lake level control. These rights are discussed in light of Florida case and statutory law. Due to the abundance of easily tapped growndwater sources, Florida's lakes and streams have not been looked Florida's lakes and streams have not been looked upon as a source of water supply by major consumptive users; both agricultural and industrial. Florida's water law with respect to consumptive uses has generally developed within the riparian system. Early cases put primary emphasis upon riparian rights of use for domestic purposes. Reasonableness of the use was not a consideration. Today, the state of Florida law with respect to withdrawal for consumptive uses is clear. Florida cases are here examined and a municipality's right, as a riparian owner, to withdraw water to supply its inhabitants is discussed. (See W70-04013). (Marsee-Florida) see-Florida) W70-04017

FLORIDA'S LAKES (RIGHTS OF THE PUBLIC),

F. Maloney, and S. Plager. U Fla L Rev, Vol 13, No 1, p 55-63, Spring 1960. 9 p, 47 ref, append.

Descriptors: *Florida, *Public rights, *Non-consumptive use, *Navigable waters, Lakes, Riparian rights, Judicial decisions, Eminent domain, Legislation, Navigation, Recreation, Fishing, Hunting Boating, Access routes, Parks, Shores, Regulation, Recreation demand, Lake beds, Relative rights, Swimming, Legal aspects, State governments, High water mark.
Identifiers: View.

The establishment of navigability is presently the foundation of public rights in Florida's lakes; however, the nature and extent of such rights have received very little judicial or legislative consideration. The mere fact that a lake is navigable does not guarantee public access to it. Courts generally agree that members of the public have no right to cross private property to reach navigable waters.

The use of legislation or eminent domain may possibly be a means of establishing such public access. As to rights of passage and recreation along the shore of a navigable lake, since Florida holds that the riparian owner owns only to the high water mark, it may be that the public will have a right to the land between the high and low water marks. Once on a navigable lake in Florida, a member of the public has a right to use it for boating, swimming, fishing, and hunting, all subject to regulation. The right of the public to scenic enjoyment of navigable waters has not been discussed by Florida courts. Even if recognized, however, the right will have to be weighed against other public interests. (See W70-04013). (Marsee-Florida) W70-04018

FLORIDA'S LAKES (RIGHTS OF COMMERCIAL USERS), F. Maloney, and S. Plager. U Fla L Rev, Vol 13, No 1, p 53-73, Spring 1960. 11 p. 62 ref, append.

Descriptors: *Florida, *Consumptive use, *Non-consumptive use, *Non-navigable waters, Commercial fishing, Boating, Hunting, Public rights, Relative rights, Judicial decisions, Legislation, Legal aspects, State governments, Lakes, Land tenure, riparian rights, recreation demand, Regulation, Leases, Lake beds, Access routes, Trees, Crustaceans, Ownership of beds. Identifiers: Minerals, Sponges.

Non-consumptive commercial uses of Florida's navigable lakes fall into two categories: commercial navigation, and commercial fishing and hunting. Subject to regulation of unreasonable uses, a riparian owner may for commercial purposes make access to navigable lakes available to the public, and members of the public may engage in commercial fishing. Consumptive commercial uses of navigable lakes include: consumptive use of the water; and uses that are consumptive of mineral deposits underlying the lake or of substances on the bed, such as sponges, crustaceans, or cypress trees. As relates to consumptive use of things on or under lake beds, Florida has legislatively authorized the sale of minerals and timber under navigable waters, as well as the sale or leasing of the right to drill for petroleum and gas. A determination that a lake is non-navigable generally excludes the public from the use of the lake. Such lake may be owned by one or more individuals who may control it as any other piece of realty. The relative rights of such multiple owners of the lake are discussed as well as the state's right to regulate such lake. (See W70-04013). (Marsee-Florida)

WATER SUPPLY DISTRICTS.

Mo Ann Stat secs 247.010 thru 247.220 (1959), as amended, (Supp 1970).

Descriptors: *Missouri, *Water districts, *Water supply, *Water management (Applied), Legal aspects, Legislation, Water works, Water resources development, Water allocation (Policy), Water dis-tribution (Applied), Sanitary engineering, Public utilities, Water rates, Condemnation, Water utilization, Eminent domain, Administrative agencies, Administration, Conduits, Environmental sanitation, Civil engineering, Construction, Main-

Public water supply districts, as Missouri political corporations, promote public health and sanitation and provide conveniences in the use of water, namely ample quantity and pure and wholesome quality. Procedures for the formation of a public

water supply district are enumerated. Each district is authorized to purchase or otherwise acquire water for the necessities of the district; to build, acquire by purchase or otherwise enlarge, improve, extend and maintain a system of waterworks; and to acquire private property by condemnation. The water supply district sells and distributes water to the inhabitants of the district and to consumers outside the district and fixes rates for the sale of water. A board of directors manages the business and affairs of the district. The organization and operation of the board is regulated. Methods of financing district projects are enumerated. The district has the right to lay its mains in public highways, roads, streets, and alleys in the district. The procedure for condemnation of property is designated. The district which is dependent upon purchases of water to supply its needs may sell and convey part or all of its water mains, plant, real estate, or equipment to any water corporation. The procedure for dissolu-tion of a public water supply district is enumerated. (Powell-Florida) W70-04022

SEWER DISTRICTS (CONSTRUCTION OF SEWERS IN UNINCORPORATED JURISDIC-TIONS).

Mo Ann Stat secs 249.430 thru 249.667 (1959), as amended, (Supp 1970).

Descriptors: *Missouri, *Public utility districts, Sewage districts, *Sewers, Legal aspects, Legislation, Construction, Maintenance, Local governments, Engineering structures, Sewage disposal, Administrative agencies, Condemnation, Eminent domain, Right-of-way, Assessments, Project planning, Jurisdiction, Construction costs, Cost alocation, Operation and maintenance, Financing, Cost-benefit theory.

A majority of the landowners residing in an unincorporated area may petition the county court to establish a sewer district and provide for construction of sewers therein. The county court may designate the county highway engineer to serve as sewer engineer. The sewer engineer is responsible for advising the county court in matters relating to the establishment and maintenance of a sewer district. Sewers may be constructed to serve more than one sewer district when the county court deems this necessary. The court may condemn land or other property to secure rights-of-way for sewer construction, or for construction of other improvements. Provisions are set forth for the apportionment of costs among landowners within the district. Upon the recommendation of the sewer engineer, the county court may levy special assessments for the operation, maintenance, and repair of sewers within the district. Procedures for dissolutionment of a district are provided. (Powell-Florida) W70-04023

CLASS TWO COUNTIES - SEWER DISTRICTS. Mo Ann Stat secs 249.760 thru 249.810 (1959).

Descriptors: *Missouri, *Sewage districts, *Sewage treatment, *Sewage disposal, Legislation, Legal aspects, Land tenure, Boundaries (Property), Contracts, Regulation, Ditches, Utilities, Jurisdiction, Construction, Condemnation, Rates, Maintenance, Financing, Outlets, Repairing, Taxes, Estimated costs, Local governments, Pollution abatement. Identifiers: *Sewer districts, Bonds.

Any contiguous area lying within a second class county may be incorporated as a sewer district upon the filing of a petition with the circuit court by a majority of the property owners in such area. The petition will give the reasons a sewage treat-ment facility and sewer system are needed. The inment facility and sewer system are needed. The in-corporation process is outlined. Sewer districts shall have the power to: (1) elect a board of super-visors to manage district affairs; (2) contract and acquire property; (3) lay sewer lines in public road-ways; (4) furnish sewage disposal outlets and con-struct, acquire, improve, operate, maintain and ad-minister disposal systems, sewage treatment plants,

Field 06—WATER RESOURCES PLANNING

Group 6E-Water Law and Institutions

mains, laterals, drains and other appurtenances incidental thereto; (5) authorize the use of their facilities by other governmental subdivisions so far as the facilities' capacities are sufficient beyond the needs of the district; and (6) be parties to joint cooperative projects. The board of supervisors will establish rates for the use of the sewer districts' facilities District administration and dissolution are provided for. The methods of financing through taxation and bond issuance are outlined. (Keith-Florida) W70-04024

FISH AND GAME (THE WILDLIFE AND FORESTRY LAW).

Mo Ann Stat secs 252.010 thru 252.230 (1959).

Descriptors: *Missouri, *Fish management, *Fish Descriptors: *Missouri, *Fish management, *Fish conservation, *Water pollution effects, Legislation, Legal aspects, Wildlife, Fish, Aquatic life, Regulation, Administrative agencies, Permits, Wildlife management, Wildlife conservation, Rivers, Streams, Dams, Nets, Weirs, Fish barriers, Fish ladders, Fish passages, Pollutants, Explosives, Water pollution, Fishkill, Fish hatcheries, Supervisory control (Power). Identifiers: *Penalties (Criminal).

Wildlife includes all wild birds, mammals, fish and aquatic life. No wildlife will be taken except in the manner, to the extent and at the times permitted by the Conservation Commission. Commission agents may search creels, containers, gamebags, autos and boats which the agents have reason to believe contain unlawfully transported or possessed wildlife. Persons owning or operating dams will erect and maintain a fishway or other device which will enable fish to have free passage through such dams. If such devices are impractical, the Commission may require the establishment of hatcheries to stock the waters above and below the dams. It is unlawful for any person to place any seine, screen, net, weir, fish dam, or other obstruction across any watercourse to obstruct the free passage of fish. It is unlawful for any person to cause any deleterious substance or explosive to be placed into any waters in quantities sufficient to injure or kill fish. Criminal penalties are provided for violation of any of the provisions of this chapter. (Keith-Florida)

LEASES OF FEDERAL RESERVOIR LANDS FOR RESORT PURPOSES.

Mo Ann Stat secs 253.290 thru 253.320, as amended, (Supp 1970).

Descriptors: *Missouri, *Administrative agencies, *Leases, *Land development, Operation and maintenance, Federal government, Construction materials, Construction, Conservation, Architec-ture, Design, Land management, Land use, Legal aspects, Legislation, Reservoirs, Recreation facili-ties, Parks.

The Missouri Park Board may grant leases for the development of resort facilities on federal reservoir lands which have been purchased by the state.

Leases may not exceed fifty years in duration.

Leases are to be granted only on the basis of competitive bidding. The Board retains the right to enter leased lands at all times. The Board may control the quality of construction materials used in the facilities and may regulate the fees charged to the public for use of the facilities. Lessees must maintain and conserve the lands and keep accurate records of their operations. Lessees may execute construction mortgages, subject to the Board's approval. (Duss-Florida) W70-04027

WATER RESOURCES BOARD. Mo Ann Stat secs 256.180 thru 256.260 (1959), as amended, (Supp 1970). Descriptors: *Missouri, *Administrative agencies. *Water resources, *Water resources development, Surveys, Data collection, Investigations, Grants, Bodies of water, Federal government, Regulation, Legislation, Water management, Water utilization, Real property, Legal aspects.

A Water Resources Board is hereby created. It is the duty of the Water Resources Board to develop a long-range, comprehensive, state-wide program for the conservation, development, management, and use of state water resources. The Board is to collect data and make surveys, investigations, and recommendations concerning water resources and their relation to social and economic needs. The Board will act as a clearing house for water resources data collected by other agencies. It may enter upon any lands or waters for investigative purposes. The Board may cooperate with the United States or any federal or state agency. The Board must employ an engineer experienced in water resources as its executive director. The Governor may delegate additional authority to the Board. (Duss-Florida)
W70-04028

WATER CONSERVANCY DISTRICTS. Mo Ann Stat secs 257.320 thru 257.490 (1959).

Descriptors: *Missouri, *Water districts, *Water conservation, *Taxes, Government finance, Administrative agencies, Water management (Applied), Legal aspects, Legislation, Financing, Economics, Administration, River basins.

The types of funds which may be used by a conservancy district and the use of money acquired as aid from a public agency are described. Tangible property within the district may be taxed. General obligation bonds may be issued by the board of trustees of a river basin conservancy district. The procedures for disincorporation of a conservancy district are enumerated. (Powell-Florida)

BOUNDARIES BY WATERCOURSES. Mo Ann Stat sec 46.010 (1966).

Descriptors: *Missouri, *Watercourses (Legal), *Boundaries (Property), *Channels, Legislation, Surveys, Local governments, Legal aspects, Water law, Jurisdiction. Identifiers: Counties.

Whenever a county is bounded by a watercourse the boundary shall be construed to be the middle of the main channel of the watercourse. Range, township, and sectional lines shall be construed as conforming to the established surveys. (Schram-Florida) W 70-04039

TAXATION OF BRIDGE AND PUBLIC UTILITY COMPANIES.

Mo Ann Stat secs 153.030, 153.040 (1952).

Descriptors: *Missouri, *Taxes, *Bridges, *Public Descriptors: "Missouri, "Taxes, "Bridges, "Public utilities, Legislation, Assessments, Tax rate, Railroads, Cities, Local governments, Electric power, Real property, Pipelines, Payment, Utilities, Navigable waters, Streams.

Identifiers: *Toll bridges.

All private bridges over streams dividing this state from other states, all toll bridges across navigable streams, and all property owned by public utility companies are subject to taxation for state, county, municipal, and other local purposes to the same extent as the property of private persons. Taxes on these properties shall be levied and collected in the same manner as provided for the taxation of railroad property. Details of the taxation procedures are provided. In cases where a part of any bridge is in this state and a part in another state, only the in this state and a part in another state, only the portion of the bridge in this state shall be subject to assessment and taxation. (Schram-Florida)

W70-04042

NATIONAL RIVERS AND HARBORS CONGRESS SUPPORTS A COMPREHENSIVE WATER RESOURCES DEVELOPMENT PRO-GRAM.

William J. Hull.

Congressional Record, 91st Cong, 1st Sess, Sept

Descriptors: *Water resources development, *Pro-Descriptors: *Water resources development, *Project planning, *Federal project policy, *Legislation, Cost-benefit analysis, Economics, Water Resources Planning Act, Project purposes, Planning, Project benefits, River basin development, Navigation, Flood control, Low-flow augmentation, Dams, Water management (Applied), Reservoir operation, Water requirements, Administration, Multiple-purpose projects. Identifiers: Water resource objectives, Project

evaluation.

Senator Birch Bayh states that an imperative need exists for an accelerated program of comprehensive water resource development to meet the rising water requirements of increasing population and an expanding economy. Existing criteria for the evaluation of water resource development projects are needlessly restrictive. Most water resources projects produce benefits which are often overlooked, and most projects are multi-purpose whether so recognized or not. Congress should develop national water resource goals and objectives based on economic grounds and value judgments. It is argued that a river basin approach to water resource planning should be adopted by Congress and that existing procedures whereby im-provements are authorized on a project-by-project basis should be changed. This multi-purpose basin approach should apply to the whole process by which water resources projects are initiated and developed. (Caldwell-Florida) W70-04043

ADMINISTRATIVE ARRANGEMENTS FOR WATER RESOURCES DEVELOPMENT IN MONTANA,

Montana State Univ., Bozeman.

Richard Sheridan.

Montana University Joint Water Resources Research Center, (1969). 3 p OWRR Project B-004-MONT.

Descriptors: *Administrative agencies, *Political aspects, *Resource development.

Identifiers: *Politico-administrative, *Water and land resources, *Restructuring, *Efficient administrative arrangement.

This study deals with the nature of the politico-administrative aspects of resources development in Montana, with particular emphasis on water resources. An extensive bibliography has been prepared relating to the general source materials about Montana's water and land resources. A review was also made of the formal organization for natural resources administration in all of the fifty states. Finally, an analysis was made of the needed restructuring of the administrative agencies within Montana to provide an efficient administrative arrangement for water resources development.
W70-04044

6F. Nonstructural Alternatives

AN ACTIVITY ANALYSIS OF NON-STRUCTURAL PLAIN MANAGEMENT ALTERNATIVES: CHAPTER IV,
Wisconsin Univ., Madison. Water Resources

John C. Day.
Wisconsin Water Resources Center, Madison,
Final Report (Partial), p 54-111, 1969. 58 p, 20
tab, 7 ref. OWRR Project B-002-WIS.

Data Acquisition—Group 7B

Descriptors: *Linear programming, *Management, *Flood plains, *Floodproofing, Land development, Models, Rent, Zoning, Landfills. Identifiers: Site elevation.

A linear programming solution to a flood plain management problem was developed. The objective was to choose the appropriate land activities for a presently vacant tract of land lying in a flood hazard location. Two basic residential models were designed allowing for two different degrees of site elevation through the use of a land fill. Along with the programming models, an extensive 'side-calculation', employing the regression estimates of rents, the expected flood losses for all residential land use-location combinations and estimated costs for elevation and floodproofing, identified the set of activities that yielded positive rent. The solution was placed at the disposal of the flood plain manager a residential development plan that served as a guide for zoning, subdivision control, and building code regulations. (See W70-04002). (Thiuri-Cornell) W70-04003

6G. Ecologic Impact of Water Development

THE FUTURE OF THE NORTH CAROLINA COASTAL AREA.

For primary bibliographic entry see Field 05G. W70-04032

07. RESOURCES DATA

7A. Network Design

A PROPERTY OF THE RANGE OF PARTIAL SUMS,
Geological Survey, Washington, D.C.
N. C. Matalas, and C. S. Huzzen.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 33, p 252-257, 1967. 6 p, 1 tab, 8 ref.

Descriptors: *Time series analysis, *Markov processes, *Statistical methods, Probability, Stochastic processes, Time lag, Runoff forecasting, Streamflow forecasting.

Under the assumption that time series are generated by lag-one Markov processes, an investigation was made of the degree to which serial dependence and skewness affects the ratio of the range of cumulative departures from the sample range of cumulative departures from the sample mean to the sample standard deviation. From a large number of generated sequences, the mean value of k was determined for various values of N, lag-one serial correlation, p (1), and skewness. For all values of N and p (1), skewness had no effect. Within the range of values of N and p (1) for annual sequences of river discharge, the average of values agrees with that found in observed sequences. This indicates that a lag-one Markov sequences. This indicates that a lag-one Markov process may be a good approximation to the generating process of sequences of annual river discharge and that apparent long-term movements in these sequences are chance events. (Knapp-USGS) W70-03701

DISTRIBUTION OF INTERIOR LINK LENGTHS IN NATURAL CHANNEL NET-WORKS.

IBM Watson Research Center, Yorktown Heights,

For primary bibliographic entry see Field 02E. W70-03878

EXTENSION OF RAINFALL RECORDS BY INTERSTATION CORRELATION, Stanford Univ., Calif. Dept. of Civil Engineering.

Molina Medardo

Available for \$2.00 per copy, from Stanford University, School of Engineering, Stanford, California 94305. Technical Report No 123, Dec 1969. 128 p, 24 fig, 16 tab.

Descriptors: *Precipitation, *Hydrologic data, *Correlation analysis, California. Identifiers: Guatemala, Venezuela, Interstate cor-

The feasibility of extending short precipitation records by correlation with nearby stations having longer records is explored. Analysis is made for annual, monthly, and daily data. Linear regression analysis is used with a random term to allow for departures from the mean relation. Data from California, Guatemala, Venezuela are used in the study. The study indicates that an initial period of record of about 15 years is adequate to establish the correlation required and that extension to stations up to 60 miles from the base station is possible when regional variability of rainfall is high and that even longer distances are possible where regional variability is relatively low. Technique is specifi-cally designed to be of value in developing countries where few long-record rainfall stations exist. (Linsley-Stanford) W70-03932

7B. Data Acquisition

GAMMA-RAY SPECTROSCOPY AS A TOOL FOR A RAPID INVESTIGATION OF DETRITIC CORES,

Centre National de la Recherche Scientifique, Gif-sur-Yvette (France). Centre des Faibles Radioactivities

Lydie Chenouard, and Claude Lalow Journal of Sedimentary Petrology, Vol 39, No 4, p 1477-1483, Dec 1969. 7 p, 5 fig, 3 tab, 12 ref.

Descriptors: *Gamma rays, *Spectroscopy, *Analytical technique, *Sediments, *Detritus, Cores, Stratigraphy, Climatic zones, Potassium, Particle size, Radium radioisotopes, Sedimentation rates, Geochemistry.
Identifiers: Gamma-ray spectrometry.

The nondestructive gamma-ray spectroscopy of a sedimentary core was used to identify five great zones of variation of potassium and thorium content in Atlantic continental shelf sediments. A sedimentological and paleoclimatic study shows that those variations correspond to climatic fluctuations. It is then concluded that nondestructive gamma-ray spectroscopy may be a valuable tool for a rapid investigation of sedimentary cores.
(Gabriel-USGS) W70-03650

USER TRIALS OF A SUBMERSIBLE WATER QUALITY RECORDING METER, Ontario Water Resources Commission, Toronto.

Great Lakes Survey Program. For primary bibliographic entry see Field 05A. W70-03662

INFRA-RED DETERMINATION OF THE QUARTZ IN SEDIMENTS AND SEDIMENTARY ROCKS,

Liverpool Univ. (England). Dept. of Oceanog-

raphy.
R. Chester, and R. N. Green.
Chemical Geology, Vol 3, No 3, p 199-212, Sept 1968, 14 p, 8 fig, 2 tab, 13 ref.

Descriptors: *Quartz, *Infrared radiation, *Analytical techniques, *Sediments, Sedimentary *Analytical techniques, 'Sedments, Sedments, Trocks, Spectrophotometry, Rock properties, Particle size, Sampling, Laboratory tests, Methodology. Identifiers: *Infrared technique, *Quartz adsorption band, Potassium bromide discs.

An infrared technique is described for use in making rapid, accurate determination of quartz. Quartz

is an important component of many sediments and sedimentary formations, and information on its destribution is necessary for interpretation of ecological, mineralogical and geochemical conditions of deposition. The technique described utilizes introduction of sediment samples to the spec-trophotometer in a solid form as KBr discs, and is made quantitative by controlling the volume of material in each disc. Quartz content of 16 sedimentary rocks and synthetic standards were analyzed by the technique; results are in good agreement with those obtained by chemical and X-ray methods. (Lang-USGS) W70-03678

PHOTOGRAPHS FOR WATER RESOURCES STUDIES,

Geological Survey, Washington, D.C. William J. Schneider.

Photogrammetric Engineering, p 257-262, Mar 1968. 6 p, 8 plate.

Descriptors: *Aerial photography, *Water resources, *Surveys, *Investigations, Water temperature, Water pollution sources, Vegetation effects, Topography, Land use, Water quality, Hydrogeology.

Identifiers: Color aerial photography, Infrared.

Air-photo interpretation is very well suited to water resources studies where limited observations of hydrologic data must be extended to regional characteristics for large areas. It is also useful in monitoring the hydrologic regimen of an area to detect possible changes. Color aerial photography is generally superior to black-and-white photography for these water resources investigations. Depth penetration through water, and excellent discrimination of water indicators, such as vegetation, are its main assets. Meaningful interpretation of the photography depends on adequate ground control data. Experiences of the Water Resources Division, U.S. Geological Survey, indicate that the best interpretation is done by professional person-nel-engineers, geologists, and water chemists intimately associated with a particular water resources project for which the photography has been obtained. (Knapp-USGS)
W70-03680

DESIGN OF A NEUTRON SCATTERING WATER CONTENT GAGE FOR SOILS, Illinois Univ., Urbana.

Kenneth Preiss.

In: Isotope Techinques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 22-27, 1967. 6 p, 5 fig, 7 ref.

Descriptors: *Nuclear moisture meters, *Calibrations, *Neutron absorption, *Soil moisture meters, *Radiosotopes, Gamma rays, Radioactivity techniques, Gages, Cadmium radioisotopes, Fluc-

tuation, Organic matter.
Identifiers: *Neutron scattering, Beryllium, Plutonium 239, Actinium 227, Americium 241.

Errors in the reading of a neutron scattering water content gage due to the chemical composition of the soil and to statistical fluctuations in the source emission rate are discussed. The effect of each cause of error may be minimized by correct design of the apparatus. The collision processes that may occur between neutrons and the atoms of a soil are described. It is shown that trace quantities of particular elements in the soil can reduce the reading, but a simple cadmium cover around the detector will eliminate their effect. Equations are given relating error in water content reading with the ordinate and slope of the calibration curve. Using these equations, it is shown that the time required to attain a given standard error in water content reading depends upon the distance between source and detector; a source to detector distance exists which gives a least time for a given error. (Carstea-USGS)

Field 07—RESOURCES DATA

Group 7B—Data Acquisition

DEVELOPMENT OF A RADIOISOTOPE GAGE FOR MONITORING SEDIMENT CONCENTRA-TION IN RIVERS AND STREAMS, Panametrics, Inc., Waltham, Mass. Bach Sellers, Charles A. Ziegler, and John

Papadopoulos.

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 3-10, 1967. 8 p, 5 fig, 1 tab, 1

Descriptors: *Radioactivity techniques, *Sediment discharge, *Suspended load, *Monitoring, Gages, Streams, Rivers, Water control, Water conservation, X-rays, Cadmium radioisotopes, Instrumenta-

Identifiers: Sediment concentration gaging.

A radioisotope gage has been developed to satisfy the need for a self-powered, continuous monitoring system of sediment concentrations in rivers and streams. This gage uses X-rays from Cd 109. Basically the gage records the ratio of X-ray transmission through water containing suspended sediment and a reference cell containing distilled water. The instrument is capable of recording at 15 minute ininstrument is capable of recording at 13 minute intervals over a period of 7 1/2 days with an accuracy better than 20% for sediment concentrations ranging from 1,000 to 50,000 ppm. The radioisotope gage has been field tested and it is being delivered to member agencies of the U.S. Inter-Agency Sediments. mentation Project for extended test and evaluation over a one-year period. (Carstea-USGS) W70-03687

DOWNWARD MOVEMENT OF SOIL MOISTURE TRACED BY MEANS OF HYDROGEN ISOTOPES, Heidelberg Univ. (West Germany). Physics Inst., SOIL

C-14 Lah

For primary bibliographic entry see Field 02G. W70-03689

THE APPLICATION OF ISOTOPES TO SOME PROBLEMS IN ATMOSPHERIC SCIENCES, Atomic Energy Commission, Washington, D.C. Biology and Medicine Div. For primary bibliographic entry see Field 02B. W70-03690

CONTRIBUTION OF ISOTOPE TECHNIQUES TO THE STUDY OF SOME HYDROLOGICAL PROBLEMS,

International Atomic Energy Agency, Vienna (Austria).

For primary bibliographic entry see Field 02A. W70-03694

APPLICATION OF DEUTERIUM ANALYSES TO THE HYDROLOGY OF THE LAKES OF THE GRAND COULEE, WASHINGTON, Geological Survey, Denver, Colo.; and Woods Hole Oceanographic Institution, Mass.

For primary bibliographic entry see Field 02K. W70-03696

ULTRA-LOW VELOCITY MEASUREMENT IN A STRATIFIED RESERVOIR BY ISOTOPIC CURRENT METER,
Tennessee Valley Authority, Norris. Engineering

Lab.

For primary bibliographic entry see Field 02H. W70-03697

MINIMIZING NUCLEAR SOIL DENSITY AND MOISTURE CONTENT GAGE ERRORS, North Carolina State Univ., Raleigh. Robin P. Gardner. Highw Res Rec, No 290, p 1-8, 1969. 8 p, 15 ref.

Descriptors: *Nuclear moisture meters, Neutron counters, *Errors, Variability, Soil density, Soil mechanics, Soil moisture, Gamma rays, *Soil moisture meters, Moisture content, Calibrations, Bibliographies, Measuring instruments, Mathematical analysis, Mathematical models, Moisture

Identifiers: *Nuclear density meters, Neutron moderation method, Control equipment, Accuracy, Testing equipment.

Sources of error in nuclear soil density gages are identified as sensitivity to variations in sample composition, poor calibration techniques, and sensitivity to surface heterogeneities. Errors associated with nuclear moisture content gages are identified as sensitivity to soil composition, sensitivity to soil density, and poor calibration techniques. Several approaches are evaluated for minimizing these sources of error, including mathematical analyses of the nuclear gaging principles, the calibration model method, and the dual-gage principle for nuclear density gages. The primary source of error for the gamma-ray density gage was sensitivity to soil composition. Mathematical model studies of the gamma-ray density gage indicated that changes in any single gage design parameter minimized errors caused by variations in soil composition only at the expense of increasing errors caused by surface heterogeneities. Mathematical analysis of neutron soil moisture gages has had limited success. The calibration model method shows promise for minimizing sources of error for the neutron moisture gages and the dual-gage principle for the gamma-ray density gages. (USBR)
W70-03787

APPLICATION OF PORE PRESSURE MEASUREMENTS TO SHEAR STRENGTH OF COHESIVE SOILS,

Bureau of Reclamation, Denver, Colo. H. J. Gibbs, and C. T. Coffey. Bur Reclam Rep No Em-761, June 1969. 56 p, 38 fig, 3 tab, 10 ref, 3 append.

Descriptors: *Pore air pressures, *Negative pore pressure, *Pore water pressures, Capillarity, Effective stress, Soil compression tests, Soil tests, *Test procedures, Triaxial shear, Shear strength, *Pore pressure, Research and development, Cohesive soils, Laboratory tests, Soil strength, Soil engineering, Soil mechanics, Triaxial compression.
Identifiers: Triaxial tests, Soil suction, Undrained

tests, Exposed end plate method, Unsaturated soils, Testing equipment.

An accurate method of measuring pore pressure in soils is necessary for determining stress when designing soil structures. The Bureau of Reclamation has made the following advances in measuring negative pore pressures: (1) The exposed end plate method of measuring the initial negative pore pressure of soils. Negative pore pressure can be determined on a routine laboratory testing basis without damaging the specimens for further testing. (2) Measuring capillary pressure throughout the volume change range as the undrained (sealed) specimens are compressed from initial negative pore pressure to the point where the capillary pressure becomes zero at saturation. Results of this test conducted on one of a series of specimens, together with results of the exposed end plate test on each specimen of the series are applied in the analysis of soil strength from shear test results. (3) Improved accuracy in measuring pore air pressure by separat-ing the water film in the soil from the end plate measuring device and controlling the end plate so that water is not drawn into or from the soil. Variable soil stress conditions that would be introduced by changing soil moisture conditions are eliminated. (USBR)
W70-03788

BATTERY POWERED PROPORTIONAL

STREAM WATER SAMPLER,
Forest Service (USDA), Corvallis, Oreg. Pacific Northwest Forest and Range Experiment Station. R. L. Fredriksen.

Water Resources Research, Vol 5, No 6, p 1410-1413, Dec 1969. 4 p, 4 fig.

Descriptors: *Sampling, *Instrumentation, *Water quality, Water analysis, Data collections, Automation, Equipment. Identifiers: Water samplers.

A stream water sampler was designed and tested to sample water from a stream at a rate proportional to the streamflow rate. A composite of samples taken in this manner is an estimate of the mean concentration of constituents carried by the stream while the sample was collected. The instrument is suitable for estimates of transport of suspended or dissolved constituents in small streams. The sampler can be built for under \$1000. (Knapp-USGS) W70-03856

A TEN-UNIT WATER LEVEL SENSING AND RECORDING SYSTEM.

Maryland Univ., College Park. Robert M. Ragan, and Alan B. Hais. Water Resources Research, Vol 5, No 6, p 1414-1417, Dec 1969, 4 p, 2 fig.

Descriptors: *Water levels, *Water level fluctuations, *Sampling, Automation, Instrumentation, Equipment, Stream gages. Identifiers: Water level recorders.

An instrument to record a number of water levels on one chart for field studies was developed around a float-pulley mechanism attached to the shaft of a potentiometer. A timing circuit allows one 6second recording cycle each minute for each of 10 sensors. Drift due to battery drain has not been encountered, and field performance has been satisfactory at a total cost of less than \$400. (K-napp-USGS) W70-03857

APPLICATIONS OF COLOR AERIAL. PHOTOGRAPHY TO WATER RESOURCES STUDIES.

Geological Survey, Washington, D.C. William J. Schneider, and Milton C. Kolipinski. Reprinted from Proc 1969 Seminar on Remote Sensing. Geological Survey Duplicated Report, p 257-262, 1969. 6 p, 16 ref.

Descriptors: *Aerial photography, *Water resources, *Surveys, *Investigations, Water temperature, Water pollution sources, Vegetation effects, Topography, Land use, Water quality, Hydrogeology.

Identifiers: Color aerial photography, Infrared.

Air-photo interpretation is very well suited to water resources studies where limited observations of hydrologic data must be extended to regional characteristics for large areas. It is also useful in monitoring the hydrologic regimen of an area to detect possible changes. Color aerial photography is generally superior to black-and-white photography for these water resources investigations. Depth penetration through water, and excellent discrimination of water indicators, such as vegeta-tion, are its main assets. Meaningful interpretation of the photography depends on adequate ground control data. Experiences of the Water Resources Division, U. S. Geological Survey, indicate that the best interpretation is done by professional personnel-engineers, geologists, and water chemists intimately associated with a particular water resources project for which the photography has been obtained. (Knapp-USGS)
W70-03869

DETERMINING SPECIFIC YIELD OF THE OGALLALA AQUIFER BY THE NEUTRON METHOD,

Agricultural Research Service, Bushland, Tex. Southwestern Great Plains Research Center For primary bibliographic entry see Field 02F.

Evaluation, Processing and Publication—Group 7C

RADIOCARBON DETERMINATIONS APPLIED TO GROUNDWATER HYDROLOGY.

Geological Survey, Washington, D.C.; and Geological Survey, Denver, Colo. For primary bibliographic entry see Field 02F. W70-03890

DEVELOPMENT OF ISOTOPE METHODS AP-PLIED TO GROUNDWATER HYDROLOGY, Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotopes. A. Nir.

In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 109-116, 1967. 8 p, 5 fig, 10

Descriptors: *Radioisotopes, *Radioactivity techniques, *Tracking techniques, Radioactive dating, Underground storage, Dispersion, Research and development, Groundwater movement, Hydrology, Hydrologic cycle, Hydrogeology. Identifiers: Isotopes in groundwater hydrology.

A survey of development of isotope methods in hydrology reveals that the initial high hopes have been only partly fulfilled. Only a few defined areas of specific and local application have been ad-vanced, such as determination of point velocity, aquifer storativity, hydrodynamic dispersion coeffi-cients, and transit times through age determination. A critical evaluation of present methods of isotope data interpretation to groundwater analysis in-dicates that the assumptions made and the results obtained are often not compatible with the problems and approaches of the practicing hydrologists. Modifications of this approach may, however, enable comparison of isotope survey results with those obtained by other conventional results with those obtained by other conventional methods. More basic contribution of isotope methods to hydrology seems feasible in view of this analysis and of the state of experimental techniques. It first requires, however, a more concerted effort in selected hydrological basins where diverse isotope and conventional methods could be applied and evaluated in close cooperation between hydrologists and the physical (isotope) scientists. The international hydrological decade offers a suitable opportunity for such an undertaking on a regional scale. (Carstea-USGS) W70-03891

GROUNDWATER FLOW AND DIRECTION MEASUREMENT BY MEANS OF RADIOISOTOPES IN A SINGLE WELL, For primary bibliographic entry see Field 02F. W70-03892

USE OF CHEMICAL AND RADIOACTIVE TRACERS AT THE NATIONAL REACTOR TESTING STATION, IDAHO, National Reactor Testing Station, Idaho Falls,

For primary bibliographic entry see Field 02F. W70-03893

LARGE-SCALE UTILIZATION OF TRITIUM IN HYDROLOGIC STUDIES,

Stockholm Univ. (Sweden). International Meteorological Inst. For primary bibliographic entry see Field 02A. W70-03894

RADIOCARBON AGES OF GROUNDWATER IN AN ARID ZONE UNCONFINED AQUIFER, Instituto Venezolano de Investigaciones Cientificas, Caracas.

For primary bibliographic entry see Field 02F. W70-03895

TECHNIQUES OF GROUNDWATER TRACING

USING RADIONUCLIDES, Atomic Energy of Canada Ltd., Chalk River (On-

For primary bibliographic entry see Field 02F. W70-03896

FRACTIONATION OF TRITIUM AND DEU-

TERIUM IN SOIL WATER, Geological Survey, Washington, D.C. For primary bibliographic entry see Field 02G. W70-03897

ENVIRONMENTAL TRITIUM STUDIES AT THE NATIONAL REACTOR TESTING STA-TION.

Atomic Energy Commission, Idaho Falls, Idaho. For primary bibliographic entry see Field 05B. W70-03898

THE USE OF A TRACER TEST TO VERIFY AN ESTIMATE OF THE GROUNDWATER VELOCITY IN FRACTURED CRYSTALLINE ROCK AT THE SAVANNAH RIVER PLANT NEAR AIKEN, SOUTH CAROLINA,

Geological Survey, Aiken, S.C. For primary bibliographic entry see Field 02F. W70-03899

WATER TRACING IN THE HYDROLOGIC CY-

International Atomic Energy Agency, Vienna

For primary bibliographic entry see Field 02A. W70-03900

THE USE OF REMOTE SENSING IN WATER RESOURCE MANAGEMENT.

Stanford Research Inst., Menlo Park, Calif. Robin I. Welch.

Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 227-242. 8 fig, 3 tab, 3 ref.

Descriptors: *Remote sensing, *Water resources, *Water management (Applied), Synoptic analysis, Analytical techniques, Marine plants, Planning, Water pollution, Aquatic environments, Aerial photography, Light quality, Dye releases, Oysters, Fluorometry, California, Silting. Identifiers: Data acquisition, Marine resources, Freshwater resources, Multiband aerial photography, Underwater photography, Infrared photography, Kelp inventories, Oil pollution, Water movement, Humboldt Bay (Calif), San Diego Bay (Calif), Rhodamine B, Rhodamine WT, Russian River (Calif), Austin Creek (Calif), Lake Tahoe (Calif), University of California (Davis).

Because problems of water quality management are diverse and complex, data must be utilized from many sources, ranging from synoptic aerial surveys by remote sensing to painstaking laboratory analy-sis. Remote sensing acquires information about an object which is not in intimate contact with the information-gathering device. Application of remote sensing techniques, principally photographic, to various marine and freshwater resources in Califorvarious marine and nestwater resources in califor-nia are described, including mapping of water movements, detection of general pollutants, detec-tion of oil pollution, and inventory of kelp beds. Ex-tensive information tabulated in the report includes photographic specifications for various applica-tions, film-filter combinations for detection of rhodamine and pollutants in San Diego Bay, and relative utility of spectral bands in multiband detec-tion of oil pollution. Benefits of remote sensing intion of oil pollution. Benefits of remote sensing in-clude: improved analysis and inventory of aquatic environments; more effective monitoring of selected water masses; comprehensive evaluation of aquatic communities and associated terrestrial of aquatic communities and associated refeath in resources; timely evaluation of pollutional sources and effects; and improved data acquisition on resource development for maximal benefit and minimal environmental damage. Image interpretation requires careful comparison with ground truth

in a given area before meaningful extrapolations to new situations can be made. (See Vol 3, No 7, Field 5C, entry W70-02775). (Eichhorn-Wisconsin) W70-03985

7C. Evaluation, Processing and **Publication**

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO GROUND-WATER STATIONS, Geological Survey, Washington, D.C. Office of

Water Data Coordination.
For primary bibliographic entry see Field 02F.
W70-03658

BIBLIOGRAPHY OF THE GROUNDWATER RESOURCES OF NEW YORK THROUGH 1967, Geological Survey, Albany, N.Y.

For primary bibliographic entry see Field 02F. W70-03659

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO AREAL IN-VESTIGATIONS AND MISCELLANEOUS AC-

TIVITIES,
Geological Survey, Washington, D.C. Office of
Water Data Coordination.
For primary bibliographic entry see Field 02E.
W70-03663

COMMUNITIES OF OVER 1,000 POPULATION WITH WATER CONTAINING IN EXCESS OF 1,000 PPM OF TOTAL DISSOLVED SOLIDS,

Black and Veatch, Kansas City, Mo. W. L. Patterson, and R. F. Banker.

W. L. Patterson, and R. F. Banker.

Report available for sale by Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price \$0.70. Office of Saline Water Research and Development Progress Report No 462, Oct 1969. 47 p, 2 fig, 2 tab. OSW Contract No 14-01-0001-1777.

Descriptors: *Water supply, *Water quality, *Dissolved solids, Water resources, Water resources development, Water quality control, Population, Data collections, Hydrologic data.

Identifiers: Community development, Total dissolved solids.

A total of 420 communities in the United States of over 1,000 population with water supplies containing total dissolved solids in excess of 1,000 parts per million are listed. These communities in 29 states had a 1960 census population in excess of 2,770,000. These data can be used for improving water quality. (Carstea-USGS)
W70-03664

DEVELOPMENT OF MATHEMATICAL MODEL AND COMPUTER PROGRAM FOR OPTIMIZATION OF VERTICAL TUBE EVAPORATOR SALINE WATER PLANTS, Houston Research Inst., Inc., Tex. For primary bibliographic entry see Field 03A.

W70-03665

ESTIMATION OF THE PARAMETERS OF GUMBEL'S THIRD ASYMPTOTIC DISTRIBU-TION BY DIFFERENT METHODS,

Michigan Univ., Ann Arbor; and Georgia Inst. of

Tech., Atlanta.
Rolf A. Deininger, and James D. Westfield.
Water Resources Research, Vol 5, No 6, p 12381243, Dec 1969. 6 p, 1 fig, 5 ref.

Descriptors: *Statistical methods, *Probability, *Forecasting, *Droughts, Digital computers, Estimating, Least squares method, Frequency analysis. Identifiers: Gumbel's method, Fibonacci search.

Group 7C—Evaluation, Processing and Publication

Estimation of the parameters of Gumbel's third asympototic distribution of the smallest value has been accomplished in the past by the following methods: (1) the method of moments; (2) using an order statistic on the characteristic drought; and (3) using the smallest observed drought. These three methods are compared with a fourth method that uses sequential least squares and a Fibonacci search. Based on estimates of the parameters of 44 rivers in the United States, it appears that methods 1, 2, and 3 do not give a satisfactory estimate of the smallest frought in a large number of cases. The method of using an order statistic was the least successful. The use of the least squares and Fibonacci search approach gave more acceptable estimates than the other methods. (Knapp-USGS) W70-03674

AN ANALYSIS OF RUNS OF PRECIPITATION

North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering. Edward H. Wiser.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 34, p 258-267, 1967. 10 p, 4 fig, 2 tab, 7 ref.

*Precipitation (Atmospheric), nods, *Markov Descriptors: *Forecasting, *Statistical methods, *Markov processes, Stochastic processes, Probability, Monte Carlo method, Mathematical models. Identifiers: Runs of data.

Simulation of precipitation records requires information about patterns of events. One useful characteristic is the number of runs of events or nonevents of any length. Equations presently available for standard models apply for an infinite series of draws, and data must be obtained carefully in order to fit the models. Exact equations are presented for the number of runs in a specified duration for a wide class of models, including the Bernoulli and Markov models as special cases. Equations are given for the number of runs of any length, for the total number of runs, and for the total number of events. The effects of analyzing runs over a limited time period is readily obtained. Examples are given of analyses of hourly events, showing the marked effect of persistence over short ime periods. The inadequacy of standard models in describing the data is clearly demonstrated, and another model is used which more adequately accounts for the effect of persistence. (Knapp-USGS)

A MODEL FOR GENERATING SYNTHETIC SEQUENCES OF SHORT TIME-INTERVAL RAINFALL DEPTHS, Massachusetts Inst. of Tech., Cambridge. For primary bibliographic entry see Field 02B. W70-03703

A MOSAIC TECHNIQUE FOR GENERATING THE DAILY PATTERN WITHIN A SYNTHETIC FLOW SEQUENCE,

Welsh Coll. of Advanced Technology, Cardiff; and Water Research Association, Medmenham (England).

For primary bibliographic entry see Field 02A. W70-03704

THE FLUCTUATION OF WATER RESOURCES,

Kyoto Univ. Research Inst. (Japan). Disasters Prevention

For primary bibliographic entry see Field 02A.

STOCHASTIC STUDY OF CHANNEL DIS-TRIBUTION IN RIVER BASINS,
Kyoto Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.

STATISTICAL CONSIDERATION IN RIVER MORPHOLOGY,

Institute for Water Resources, Belgrade (Yugoslavia).

For primary bibliographic entry see Field 02E.

SOME PROPOSALS OF THE STOCHASTIC METHOD OF FORECASTING FOR DEPOSITS IN RESERVOIRS,

Osaka Univ. (Japan). Dept. of Civil Engineering. For primary bibliographic entry see Field 02J. W70-03709

ADAPTIVE FILTERS FOR TREND TRAPOLATION OF RUNOFF RECORDS,

Deutsche Akademie der Wissenschaften zu Berlin (East Germany). Inst. for Physical Hydrography. Otto Czepa.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 50, p 384-388, 1967. 5 p, 1 fig, 1 ref.

Descriptors: *Streamflow forecasting, *Time series analysis, Statistical methods, Probability, Data processing, Frequency analysis. Identifiers: Data filters, Moving average methods.

To estimate the oscillatory fluctuations of a time series with a given constant period (e.g. the seasonal with a period of $P=12\ mon$) we would want to limit frequencies. Exponentially weighted want to limit frequencies. Exponentially weighted moving averages are filters which will give a reasonably good approximation for this purpose. The gain factor of weighted moving average filters and recursion formulas for numerical smoothing and extrapolation are discussed. (Knapp-USGS) W70-03710

A METHOD FOR STATISTICAL EVALUATION OF WEATHER MODIFICATION AT THE RIVER FLOW CONTROL LEVEL.

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.

For primary bibliographic entry see Field 03B. W70-03848

ELECTRICAL ANALOGUES AND DIGITAL COMPUTERS FOR ESTIMATING UNSATURATED WATER FLOW IN SOILS,

Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div For primary bibliographic entry see Field 02G. W70-03882

DETERMINING AND MAPPING AVERAGE HYDROLOGIC RESPONSE EASTERN UNITED STATES, THE

EASTERN UNITED STATES, Franklin Coll. of Arts and Sciences, Athens, Ga. James F. Woodruff, and John D. Hewlett. Available from the Clearinghouse as PB-189 524, \$3.00 in paper copy, \$0.65 in microfiche. Completion Report, Franklin College of Arts and Sciences and School of Forest Resources, University of Georgia, Athens, Georgia. Dec 1969. 33 p. OWRR Project A-013-GA.

Descriptors: *Hydrologic mapping, *Hydrologic properties, *Direct runoff, *Synoptic analysis, *Hypsometric analysis, *Terrain analysis, Streamflow, Storm runoff, Base flow, Peak flow, Hydrologic data, Hydrologic cycle, Hydrograph analysis, Regression analysis, Watersheds, Precipitation data, Gaging stations, Topography, Mans

An attempt was made to predict the average annual basin hydrologic response of ungaged watersheds in the East by regression against 15 planimetric, hypsometric and land use factors available on 90 test basins varying in size from 2 to 100 square miles. Using topographic, hydrologic, and precipitation data available regression coefficients developed relating response to basin factors proved

entirely non-significant. Studies revealed that the part of a basin's annual precipitation that will become flood waters cannot be predicted from available morphometric data on basins because response is controlled chiefly by porous mantle factors not measurable on normal data sources. A hydrologic response map of Eastern United States plotted directly from streamflow and precipitation records for 201 basins ranging up to 200 square miles indicated that the average basin response corresponded with the main geological provinces of the East. By revealing specific regions of high flood-producing potential, the map proves that the synoptic response ratio is a meaningful parameter. The authors suggest that the best way to map response may be to measure precipitation and streamflow by cheap, short-term methods tradi-tionally regected as uneconomical. The report con-tains 16 references. (Conway-Georgia Tech) W70-04008

COMPUTER STUDIES OF FINITE-AMPLITUDE

WATER WAVES, Stanford Univ., Calif. Dept. of Civil Engineering. Robert K. C. Chan, Robert L. Street, and Theodor Strelkoff

Available from the Clearinghouse as PB-189 522, \$3.00 in paper copy, \$0.65 in microfiche. Techni-cal Report No 104, June, 1969, 97 p, 4 tab, 39 fig, 36 ref. ONR Contract Nonr 225 (71) NR 062-320 and National Science Foundation Grant GK 2506. OWRR Project B-037-CAL.

Descriptors: *Waves (Water), *Digital computer. Identifiers: *Solitary wave, *Finite differences.

Two numerical techniques are utilized to study the motion of two-dimensional, finite-amplitude water waves by using an electronic digital computer. The nonlinear properties of water waves are of primary interest. The first part of the work introduces the Stanford-University-Modified MAC (SUMMAC) code which is proposed as a valid tool for analyzing incompressible, viscous flows with a free surface under transient conditions. The method is applied to the study of the solitary wave run-up on a verti-cal wall. The results are compared with the available experimental data and give a much better prediction of the wave run-up than the existing analytic theory. In the second part, Newton's process of successive corrections is applied to solve steady-state potential flows with free surface and gravity. A specific application to the analysis of solitary waves is made and all the wave characteristics are in excellent agreement with experiments. W70-04009

08. ENGINEERING WORKS

8A. Structures

TUNNELLING METHODS IN HUNGARY, Technical Univ., of Budapest (Hungary). C. J. Szechy.

Tunnels Tunnelling, Vol 1, No 3, p 131-133, Sept-Oct, 1969. 3 p, 7 fig.

Descriptors: *Tunnel construction, *Tunneling, Tunnel linings, Tunnels, Geologic formations, Geology, Foreign construction, Alinements, Waterproofing, *Engineering geology, Geologic investigations, Underground structures. Identifiers: Tunnel inverts, Tunnel supports, Hungary, Budapest (Hungary), *Subways, Subsurface openings.

While the general location of a tunnel is governed by direct traffic and transportation demands, the exact location and method of construction are subject to geological circumstances. How far the geological picture, combined with the possibilities of a relatively free access from the surface, may in-fluence the construction method is illustrated with a description of the special construction features used in building the east-west line of the new Budapest underground railway. A wide range of tunneling methods was used. Special combined techniques were necessary in constructing deep-level stations, shield-chambers, ventilation shafts, and other adjoining underground facilities. (USBR) W70-03790

DISTRIBUTION OF CONCENTRATED LOADS ON ORTHOTROPIC BRIDGE DECKS,

Dundee Univ (Scotland) Struct Eng, Vol 47, No 9, p 377-385, Sept 1969. 9 p, 11 fig, 10 ref.

Descriptors: *Bridges, Plates, Slabs, *Load distribution, Computer programs, Equations, Mathematical analysis, Series (Mathematics), Stress distribution, *Bridge design, Structural analysis, Structural engineering, Experimental data. Identifiers: *Orthotropic bridges, *Concentrated loading, Computeraided design, Comparative studies, *Bridge decks.

A general method based on a series solution of the orthotropic plate equation is presented for analyzing the distribution of concentrated loads in right orthotropic bridge decks. The method is compared to the widely adopted Guyon-Massonnet quasi-slab analysis devised before digital computers were used in structural design and necessarily embodied a number of approximations and limitations. The method is valid over a wider range than the Guyon-Massonnet analysis, and experimental evidence indicates better accuracy, particularly in computing longitudinal moments. W70-03798

DRAINAGE MASTER PLAN FOR THE CITY OF FORT WORTH PUBLIC WORKS DEPARTMENT, STORM DRAINAGE CRITERIA AND DESIGN MANUAL.

Knowlton-Ratliff-English, Fort Worth, Tex.

Fort Worth, Knowlton-Ratliff-English, Consulting Engineers, 1967. 74 p, 25 tab, 63 fig, 14 ref.

Descriptors: *Drainage engineering, *Design criteria, *Drainage programs, *Drainage practices, *Storm runoff, *Surface drainage, *Storm drains, *Flood control, Rainfall-runoff relationships, Hydrology, Hydraulic structures, Hydraulics, In-takes, Open channels, Storage, Culverts. Identifiers: *Fort Worth, *Drainage master plan,

*Gutter flows, Nomographs, Coding.

The purpose of this drainage manual is to establish standard criteria, principles, procedures, and practices for the design of storm drainage facilities within the City of Fort Worth, Texas. The manual constitutes the first phase of the development of a master plan for storm drainage to guide the design and construction of storm sewers and channels in the City and its anticipated growth area. The manual is presented in nine sections that give logical development to the solution of storm drainage problems. The introductory section covers definitions and abbreviations, code designation of drainage system elements and the degree of protection afforded. Other sections cover: determination of design discharge; flow in gutters; storm drain indeed to the control of design discharge; down in the storm draining. lets; flow in storm drains; closed storm drainage systems; design of open channels; design of culsystems; design of open channels, design of curverts; and appendices which include a glossary of terms, bibliography, and tables and suggested computation forms. Many nomographs are included to facilitate solutions to various engineering computations involved in drainage design. Tables are included presenting suggested values of design parameters for various conditions and circumstances. Relationships between rainfall and runoff, and the use of the Rational and Unit Hydrograph methods of runoff computation are included. (See also W70-03815 thru W70-03818). (Poertner-Chicago) W70-03814

SECTION I, INTRODUCTION; SECTION II, DETERMINATION OF DESIGN DISCHARGE;

SECTION IX, APPENDIX.
Knowlton-Ratliff-English, Fort Worth, Tex.

In: Drainage Master Plan for the City of Fort Worth Public Works Department, Storm Drainage Criteria and Design Manual, Knowlton-Ratliff-En-glish Consulting Engineers, Fort Worth, 1967. 19 p, 9 tab, 5 fig.

Descriptors: *Drainage engineering, *Design criteria, *Watersheds, *Time of concentration, *Runoff coefficient, *Rainfall-runoff relationships, *Hydrology, Surface drainage, Storm runoff, Bibliographies.

Identifiers: *Fort Worth, *Drainage master plan, *Glossary of drainage terms, Drainage computa-

Section I is an introduction explaining the purpose and arrangement of the manual. Division of the urban area into defined watersheds, drainage areas, and drainage sub-areas and a system of coding these elements of the drainage system are also presented. Section II, entitled 'Determination of Design Discharge sets forth six conditions which should govern the design of a storm drainage system. This section also treats methods for determination of the section also treats methods for determination. mining the amounts and rates of runoff using the Rational Method and the Unit Hydrograph Method. The Rational Method is specified for watershed areas up to 1,000 acres. Above this area, computations using both methods are specified and the greater discharge is to be used for design of the elements of the system. The use of planimetrictopographic maps of the area is recommended for determining the size and shape of watersheds. Typical runoff coefficients and graphs of rainfall intensity vs. duration and frequency are included as being representative of the Fort Worth area. A nomograph for computing 'time of concentration' is presented. Section IX constitutes an appendix which includes a glossary of terms, bibliography, and forms for use in making engineering computa-tions. (See W70-03814). (Poertner-Chicago) W70-03815

SECTION III, FLOW IN GUTTERS; SECTION IV, STORM DRAIN INLETS.

Knowlton-Ratliff-English, Fort Worth, Tex.

In: Drainage Master Plan for the City of Fort Worth Public Works Department, Storm Drainage Criteria and Design Manual, Knowlton-Ratliff-English, Consulting Engineers, Fort Worth, 1967. 56 p. 38 fig.

Descriptors: *Gutter flows, *Intakes, *Drainage engineering, *Storm runoff, *Surface drainage, *Hydraulic structures, Hydraulics, Drainage en-*Hydraunic structures, Hydraunics, Drainage engineering, Design criteria, Drainage practices, Storm drains.

Identifiers: *Fort Worth, *Gutter flows, *Street flows, *Inlets, *Inlet design, *Inlet capacity, Nomo-

graphs, Drainage design computations, Computa-

Section III presents information, a nomograph, and curves to facilitate making computations required in designing the various hydraulic properties of street gutters and roadway ditches. The nomograph and curves greatly simplify the otherwise com-plicated solutions for depth of flow of drainage runoff in gutters and the lateral spread of the water into traffic lanes. The nomograph and figures, which are graphical solutions of Manning's Equation for uniform flow, are developed for streets of different widths and roughness coefficients, and for streets with straight cross slopes and others with various size parabolic crowns. Section IV presents sketches, criteria and examples to illustrate design procedures, standards and techniques for determining hydraulic capacities and required dimensions of storm drain inlets. Three major classifications of inlets are treated; namely, (1) inlets in sumps, (2) inlets on grade without gutter depression, and (3) inlets on grade with gutter depression. Curves and computation forms are included to simplify solutions of the complicated mathematical formulas. (See W70-03814). (Poertner-Chicago)

SECTION V, FLOW IN STORM DRAINS AND THEIR APPURTENANCES; SECTION VI, DESIGN OF CLOSED STORM DRAINAGE SYSTEM; SECTION VII, DESIGN OF OPEN CHANNELS

Knowlton-Ratliff-English, Fort Worth, Tex.

In: Drainage Master Plan for the City of Fort Worth Public Works Department, Storm Drainage Criteria and Design Manual, Knowlton-Ratliff-English, Consulting Engineers, Fort Worth, 1967. 29 p, 7 tab, 6 fig.

Descriptors: *Drainage engineering, *Design criteria, *Hydraulic design, *Pipe flow, *Closed conduit flow, *Storm drains, *Open channel flow, Hydraulics, Channel flow, Concrete pipes, Metal pipes, Hydraulic structures, Drainage systems, Mannings equation, Joints, Head loss, Hydraulic gradient, Roughness coefficient.

Identifiers: *Fort Worth, *Drainage systems

design, Drainage master plan.

Section V presents criteria, procedures, formulas and roughness coefficients for use in designing the hydraulic elements of storm drains and appurtenances to storm drainage systems. A minimum mean flow velocity of 2.5 ft. per sec. is specified, as are minimum grades for various sizes of concrete pipe and corrugated metal pipe. Charts for facilitating hydraulic computations based upon the Continuity Equation and Manning Formula are included. Tables of design coefficients are included for calculating head losses at inlets, manholes, junctions, bends, obstructions and size changes. The hydraulic grade line is required to be 2 ft. or more below ground or streets. Section VI presents the overall drainage system design procedure, stepby-step, applying the criteria, techniques, formulas, coefficients and charts presented in the preceding sections of the manual. Section VII presented criteria, formulas, roughness coefficients and procedures for designing the hydraulic elements of lined and unlined open channels, rectangular and trapezoidal in cross-section, and natural ditches. The Manning Formula is the basis of design. (See W70-03814). (Poertner-Chicago) W70-03817

SECTION VIII, DESIGN OF CULVERTS. Knowlton-Ratliff-English, Fort Worth, Tex.

In: Drainage Master Plan for the City of Fort Worth Public Works Department, Storm Drainage Criteria and Design Manual, Knowlton-Ratliff-En-glish, Consulting Engineers, Fort Worth, 1967. 34 p, 3 tab, 14 fig.

Descriptors: *Culverts, *Drainage engineering, *Drains, *Outlet works, *Hydraulic design, *Storm drains, *Storm runoff, *Surface drainage, *Design urains, *Storm runoff, *Surface drainage, *Design criteria, Hydraulic structures, Pipes, Roads, Hydraulics, Drainage practices, Concrete pipes, Metal pipes, Head loss, Roughness coefficient. Identifiers: *Fort Worth, *Highway culvert design, *Highway drainage, Box culverts, Pipe culverts, Culvert sizing, Nomographs.

Section VIII defines the functions of drainage culverts, presents design criteria, establishes the method of flow determination and sets forth design formulas, coefficients and procedures for sizing various types of culverts. It is specified that the quantity of flow shall be determined by the Rational Method or the Unit Hydrograph Method. All designs are to be based on a 50 year storm frequency. 'Entrance loss' coefficients are specified for culverts constructed of concrete pipe, corrugated metal pipe and concrete box-sections--all with varying headwall end wall, and wingwall designs. Formulas are specified for hydraulic computations under various culvert flow depths and various degrees of submergence at the entrance and inlet.

Field 08-ENGINEERING WORKS

Group 8A—Structures

Seven examples of culvert sizing computations are presented. Nomographs are included for use in simplifying computations associated with the hydraulic design of culverts. Their use is illustrated in conjunction with the presentation of the design examples. (See W70-03814). (Poertner-Chicago) W70-03818

8B. Hydraulics

SIMULATION NUMERICAL WITHDRAWAL FROM A STRATIFIED RESER-VOIR.

Oregon State Univ., Corvallis, Oreg. H. T. Mercier, M. D. Terry, and L. S. Slotta. ASCE National Water Resources Engr Meeting, Memphis, Tenn, Jan 26-30, 1970. 16 p, 5 fig.

Descriptors: *Mathematical models, *Density currents, Density stratification, Numerical analysis, Computer models, Reservoirs, Density.

Modifications are presented to the MAC method for the flow of a non-homogeneous, viscous, incompressible fluid and summaries are compiled for numerical investigations of withdrawal from a density stratified reservoir. The equations of motion were developed from the system of the partial differential equations of incompressibility, continuity and the Navier-Stokes equation. Those equations were solved numerically by finite difference techniques. The research procedure was to simulate a reservoir and investigate the effects of viscosity variation, density stratification, and the presence of a submerged ridge on the flow pattern. Both the continuous and the two-layered models were used. The computation was made on a CDC 6600 computer. (Novotny-Vanderbilt) W70-03716

BEHAVIOR OF BUOYANT JET IN CALM FLUID.

Hydraulics Research Station, Wallingford (En-

gland). Habib O. Anwar.

Journal of the Hydraulics Division, Proceedings of ASCE, Vol 95, No HY4, Proc Paper 6688, p 1289-1303, July 1969. 10 fig, 13 ref.

Descriptors: *Jets, *Outlet, *Hydraulics models, *Mixing, *Buoyancy, Diffusion, Turbulence.

The investigation studied the turbulent mixing that occurs when sewage is discharged into the sea from a deeply submerged outlet, which is the case when the buoyancy forces dominate the largest part of the rising plume. The investigation was carried out by discharging freshwater from circular nozzles of 1/2 inch and 1 inch diameter, into a quiescent ambient fluid of greater density. The ambient fluid was salt solution of uniform density. The density at points in the plume was determined by measuring the concentration of the solution using an electrical conductivity probe. Conclusions were (1) it was found that the density distribution across the plume is almost Gaussian, (2) the motion in the rising plume is similar to convection over a heated source when the nozzle densimetric Froude number is low, and (3) it has been found that the results are similar to those given by Fan and Abraham and also satisfactory agreement has been found between calculations and experimental results. These calculations were made neglecting initial jet momentum and treating the plume as purely buoyant. Comparison with results of work by Frenkel and Cummings proved unsatisfactory. (Guerrero-Vanderbilt) W70-03724

DIFFUSION AND ENTRAINMENT IN TWO-LAYER FLOW,

Norges Tekniske Hoegskole, Trondheim. River and Harbor Lab. T. Carstens.

Journal of the Waterways and Harbors Division, Proceedings of the ASCE, Vol 96, No WW1, Proc Paper 7081, p 97-104, Feb 1970.

Descriptors: *Water pollution, *Salinity, *Turbulence, *Diffusion, Harbors. Identifiers: *Entrainment.

A layer of freshwater overriding a pool of seawater may extract salt from the pool of two mechanisms: (1) Diffusion; and (2) entrainment. While diffusion is a two-way transport by which equal volumes are exchanging places, entrainment is a one-way, advectival type of transport. The rates of the two vertical transports depend on the turbulence in the surface layer and in the pool. The more turbulent water mass will erode the less turbulent one and entrain it. On two occasions fluxes of water and salt past two vertical cross sections of the surface layer were measured in a fjord. In one case there was only about 10% entrainment between the two sections, in the other about 100%. (Guerrero-Van-W70-03728

UNIFIED VIEW OF DIFFUSION AND DISPER-

Illinois Univ., Urbana. Dept. of Civil Engineering. Edward R. Holley.

Journal of the Hydraulics Division, Proceedings of the ASCE, Vol 95, No HY2, Proc Paper 6462, p 621-631, Mar 1969.

Descriptors: *Dispersion, *Diffusion, *Convection,

Identifiers: Diffusion coefficient, Dispersion coefficient, Longitudinal dispersion.

The similarities among the various types of diffusion and dispersion are discussed. Diffusion and dispersion are basically convective transport mechanisms. The method chosen for representing the convection in a mass balance equation is the determining factor in deciding whether diffusion or dispersion must be included in the conservation equation for a given flow. This principle is illustrated for molecular diffusion, turbulent diffusion, and longitudinal dispersion. In a given flow, the relative importance of diffusion or dispersion in different transport problems depends on the steepness of the concentration gradient. It is proposed that the term 'diffusion' be reserved for transport that is associated primarily with time-averaged velocity fluctuations and that 'dispersion' be used for transport associated primarily with the spatial average of velocity variations. (Guerrero-Vanderbilt) W70-03729

MOTION OF TWO DIMENSIONAL STARTING

Waterloo Univ. (Ontario). Dept. of Mechanical Engineering; and New South Wales Univ., Kensington (Australia).

Gee Tsang, and Ian R. Wood.

Journal of the Engineering Mechanics Division,
Proceedings of the ASCE, Vol 94, No EM6, Proc
Paper 6321, p 1547-1561, Dec 1968. 10 ref, 6 fig.

Descriptors: *Dimensional analysis, *Density, *Stratified flow, Velocity, Buoyancy, Identifiers: *Plumes.

A motion study was made of a two dimensional starting plume with the emphasis on looking for a stream function for the surrounding fluid. Dimensional analysis is used to show that the shape and velocity distribution of the plume when expressed in a dimensionless form is a constant and that the ratio of the velocity of the leading edge to the third power of the flux of density difference times the gravitational constant from the line source is a constant, C. Experiments in which velocities were measured with neutrally buoyant particles were carried out showing that the plume consisted of a cylindri-cal cap and a wedge shaped tail and that the ratio of the radius of the cylinder to the total length of the plume, n, was approximately one third. The value

of C was 1.20 with a standard deviation of 0.03. A model in which the cap is treated as a solid moving cylinder was used to obtain a relationship between C and the rate of spread. A distribution of doublets, sources, and sinks was found which defined the flow field outside the vorticity-containing region. (Guerrero-Vanderbilt)

JET INDUCED CIRCULATION AND DIFFU-SION

Iowa Univ., Iowa City. Inst. of Hydraulic Research. Constantin lamandi, and Hunter Rouse

Journal of the Hydraulics Division, ASCE, Vol 95, No HY2, Proc Paper 6446, p 589-601, Mar 1969. 8 fig, 6 ref.

Descriptors: *Bubbles, *Diffusion, *Circulation, *Jets. Turbulent flow.

Patterns of mean flow and turbulence for various jet boundary configurations were determined. Tests were conducted in an air duct to determine the patterns of mean flow and turbulence produced by a jet emerging along an edge of the duct parallel to one of the duct walls. The parameters that have been varied include the relative proportions of the duct and a nondimensional grouping of the momentum characteristics of the jet. It has been concluded that: (1) Submerged jets provide an alternative (and even more adaptable) means of maintaining the pattern of flow for which a bubble screen is often utilized; (2) the generalized characteristics of the measured mean-flow and turbulence fields are subject to use in design over a considerable range of scales and operational conditions; and (3) until such time as similar studies have been carried out for bubble screens, an approximate method is at hand for comparing their effectiveness in terms of the information for jets presented herein. (Guerrero-Vanderbilt) W70-03734

WATER-HAMMER ATTENUATION WITH A TAPERED LINE.

Youngstown State Univ., Ohio; Carnegie-Mellon Univ., Pittsburgh, Pa. F. J. Tarantine, and W. T. Rouleau.

Trans Amer Soc Mech Eng, Ser D--J Basic Eng, Vol 91, No 3, p 341-352, Scpt 1969. 12 p, 15 fig, 11 ref, 3 disc.

Descriptors: *Water hammer, Surges, Hydraulics, *Attenuation, *Valves, Pressure, Theoretical analysis, Experimental data, *Closing, Time, Sonic waves, Velocity, Mathematical models, *Tapers, Vibrations, Reynolds number.

Identifiers: Surge waves, Test results, Wave propagation.

Pressure attenuation that can be obtained through application of a rigid tapered section located immediately upstream of a quick-closing valve or other surge-generating device was investigated. The model used was an inviscid liquid flowing through a rigid, tapered tube terminated by either a very long, uniform line or a finite-length line and reservoir. An outline of a theoretical method for solving the problem and some practical solutions are presented. A description of the experimental procedure used to validate the analytical approach and assumptions used in the analysis are given. Results of experimental determinations are compared with theoretical water-hammer calculations. Inserting a tapered section at the valve end of a long, uniform line delayed the normal pressure rise associated with water hammer. Because of the time delay, a tapered section at the valve can reduce effectively the pressure surge resulting from quick closing-reopening or opening-reclosing of valve. (USBR) W70-03785

8C. Hydraulic Machinery

UNIT SPACING OF HYDROELECTRIC MACHINES,

English Electric Co. Ltd., Whetstone,

E. G. Taylor.

Water Power, Vol 21, No 10, p 377-380, Oct 1969. 4 p, 5 fig, 6 ref.

Descriptors: *Hydroelectric plants, *Structural design, Velocity, Dimensions, *Francis turbines, *Hydraulic turbines, Pressure head, Specific speed, *Electric generators, Graphical analysis, Hydroelectric power, Turbine runners, Foreign research, Design, Spiral cases, Stators, *Power-

Identifiers: *Spacing, Great Britain, Turbine head

Designing a hydroelectric installation requires preliminary information concerning the generator and turbine. Some problems arising are: (1) the required value of fly-wheel effect--the energy constant and related speed rise and pressure rise; (2) the ability of turbine head cover to pass in one piece through the generator stator bore; and (3) dimensions of the generator air housing and spiral casing to determine whether the generator or the spiral casing dimensions fix the unit spacing. Equations are expressed as curves so that by knowing the power required and the rated head of the unit, generator and turbine dimensions and unit spacing can be solved graphically. The graphs given were derived for Francis turbines; similar graphs can be constructed for other types of turbines by using this method. From the various graphs, generator and turbine dimensions are derived; applying these dimensions to a unit spacing graph provides dimensions for the hydroelectric powerplant design. (USBR) W70-03783

8D. Soil Mechanics

INFILTRATION INDUCED SOIL INSTABILI-

Massachusetts Univ., Amherst. Dept. of Civil En-

gineering. For primary bibliographic entry see Field 02G. W 70-03648

COMPARISON OF PILE LOAD-TEST-SKIN-FRICTION VALUES AND LABORATORY STRENGTH TESTS,

Saskatchewan Univ., Saskatoon; and Sir George Williams Univ., Montreal (Quebec). W. G. Watt, P. J. Kurfurst, and Z. P. Zeman. Can Geotech J, Vol 6, No 3, p 339-352, Aug 1969. 14 p, 11 fig, 1 tab, 7 ref.

Descriptors: *Piles (Foundations), Pile friction, Foreign research, Pile bearing capacities, Pile foundations, Concrete piles, Direct shear, Skin friction, *Laboratory tests, Van shear tests, Shear strength, Soil tests, Soil engineering, Soil mechanics, Test procedures, *Friction piles, *Field tests. Identifiers: *Pile tests, *Cast-in-place piles, Loading tests, Test piles, *Comparative studies, Saskatchewan (Canada), In situ tests.

Three full-scale bored, cast-in-place concrete piles constructed to give no-tip resistance were loaded to failure using the equilibrium method of loading. Each pile was 24 in. in diameter, but of different length, stopping in turn in strata of partly saturated highly plastic clay, saturated silty clay, and till. Ulti-mate skin friction values were calculated and compared to direct shear tests and laboratory and field vane tests, giving values of undrained shear strength. Large variations were present in shear strength results even at the same depth in adjacent holes. Comparison of vane tests on soil samples and on the surface of the bored hole showed the disturbance caused by drilling to be negligible for these soils. Results from an interfacial friction

device lowered into the hole indicated that the skin friction increased with lateral stress and that the lateral pressure on the concreted piles at the time of testing was less than 10 psi. (USBR) W70-03781

PRE-EQUILIBRIUM OBSERVATIONS ON THE RECONSTRUCTED FLAGSTAFF GULLY DAM, Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia). O. G. Ingles, J. G. Lang, and B. G. Richards.

Res Pap No 116, Symp Earth Rockfill Dams, Punjab, India, Vol 1, p 162-170, Nov 1968. 9 p, 12 fig, 2 tab, 11 ref.

Descriptors: *Earth dams, *Dam failure, Dams, Embankments, *Leaching, Fills, Pore pressure, Soil chemical properties, Soil engineering, Soil mechanics, *Soil stability, Phreatic lines, Foreign research, Rockfill dams, Soluble salts, Piezometers, Seepage, Clays, Dispersion, Zoned embankments.

Seepage, Clays, Dispersion, Zoned embankments, Montmorillonite, Permeability. Identifiers: Exchangeable sodium percentage, *Piping (Erosion), Flagstaff Gully Dam (Tasmania), Australia, Peptization.

Deflocculation of the sodium-rich clay core may have contributed substantially to the piping failure of Flagstaff Gully Dam in Tasmania, shortly after first filling. Conditions for such a failure exist when water of low salinity flows through a clay soil having a high exchangeable sodium percentage at a velocity exceeding the swelling rate of the soil, resulting in salt leaching, deflocculation, and removal of soil at an ever-accelerating rate. When flow velocity is less than the swelling rate, salt leaching occurs at an ever-diminishing rate, flow channels seal off gradually by swelling, and the soil is progressively stabilized against seepage. Conclusions from observations of installations to monitor the reconstructed embankment of Flagstaff Gully Dam are presented. Initial installations showed that the potential hazard of clay deflocculation was present and could become acute in a short time. Additional installations showed that a low rate of permeability precluded an immediate hazard and ensured long-term core stability. Dissipation of construction pore pressures is extremely slow and final equilibrium will not be reached for at least 15 yr after construction. (USBR) W70-03782

ON THE EFFECTIVENESS OF SAND DRAINS,

Harvard Univ., Cambridge, Mass. L. Casagrande, and S. Poulos. Can Geotech J, Vol 6, No 3, p 287-326, Aug 1969. 40 p, 39 fig, 22 ref.

Descriptors: Drains, Drainage wells, Soil mechanics, Drainage, Soil physical properties, Soil properties, Soil strength, Consolidation, *Foundations, Peat, Relief wells, Effects, Settlement (Structure) tions, Peat, Refer wells, Effects, Settlement (Structural), Clays, Organic soils, Shear strength, Permeability, Pore pressure, Bibliographies, *Vertical drains, Field tests, *Sand drains.

Identifiers: Drain holes, Drain spacing, Soil characteristics.

teristics, In situ tests, Comparative studies, Secondary consolidation, Compressible soils.

Detrimental effects of driving sand drains in sensitive soils are discussed. Several case records of the behavior of embankments on such soils are analyzed. If careful foundation investigation indicates the desirability of increasing the rate of primary consolidation, non-displacement sand drains should be installed with minimum disturbance to the surrounding soil. Sand drains of any type are of little or no value in soils exhibiting substantial secondary settlements. Proper design of nondisplacement sand drains systems must be based on a careful study of an adequate number of undisturbed soil specimens in the partly dried condition and on in situ horizontal permeability tests, in addition to the classification, strength, and consolidation tests normally performed. (USBR)

MINIMIZING NUCLEAR SOIL DENSITY AND MOISTURE CONTENT GAGE ERRORS, North Carolina State Univ., Raleigh. For primary bibliographic entry see Field 07B. W70-03787

APPLICATION OF PORE PRESSURE MEASUREMENTS TO SHEAR STRENGTH OF COHESIVE SOILS,

Bureau of Reclamation, Denver, Colo. For primary bibliographic entry see Field 07B. W70-03788

PORE PRESSURE MEASUREMENTS IN THE FIELD AND IN THE LABORATORY, PART I AND PART II,

Imperial Coll. of Science and Technology, London

(England).
P. R. Vaughan, A. W. Bishop, and G. E. Green.
Pap, 7th Int Conf, Int Soc Soil Mech Found Eng,
Mexico, Aug 1969. 18 p, 68 ref.

Descriptors: *Pore pressure, *Pore water pressures, Field tests, Field data, *Pore air pressures, Bibliographies, *Measurement, Soil mechanics, Measuring instruments, Laboratory tests, Porous tube piezometers, Filter stones, Negative pore pressure, Instrumentation, Piezometers, Saturated soils, Pressure sensors, Soil engineering, Soil tests, Foreign research.

Identifiers: Pressure transducers, Unsaturated soils, Undrained tests, Triaxial tests, Drained tests, Great

Principles involved and methods used for making field measurements of pore pressure in saturated and unsaturated soils are discussed. Topics are suggested on which discussion and additional data would be useful for interpreting and assessing accuracy and long-term reliability of field measuring systems. Three classes of laboratory problems in measuring pore pressures are discussed: (1) undrained tests--pore pressure is uniform throughout the sample, but varies with time; (2) consolidation tests and pore pressure dissipation tests--controlled boundary drainage results in pore pressure gradients in the sample; and (3) model tests--undrained pore pressure is nonuniform. (USBR) W70-03797

8E. Rock Mechanics and Geology

GEOLOGY OF FLAMING GORGE DAM AND

RESERVOIR,
Bureau of Reclamation, Salt Lake City, Utah.
J. Neil Murdock.

Intermount Ass Geol, 16th Annu Field Conf, p 23-32, 1969. 10 p, 3 fig, 4 ref.

Descriptors: *Engineering geology, *Geologic investigations, Drill holes, Dam foundations, *Damsites, Concrete dams, Arch dams, Shales, *Foundation investigations, Abutments, Seepage, Keyways, Diversion tunnels, Cutoffs, Anchors, Grouting, Grout curtains, Landslides, Reservoirs, Reservoir sites, Rock foundations. Identifiers: Percolation tests, Seepage control, Flaming Gorge Dam (Utah), Flaming Gorge Reservoir (Utah).

The geology of Flaming Gorge Dam and Reservoir is described and some related problems in design and construction are discussed. Preliminary ex-ploration indicated that the general quality of the rock was excellent, but because of faults, joints, and clay seams, extensive geological investigations and mapping were required to obtain sufficient information for the final design of the dam and appurtenant structures. Diamond drill coring, seismic studies, and drill hole percolation tests were performed. Some problems anticipated were seepage, extra excavation to reach sound rock, and pinning of certain areas to prevent possible movement. The seepage problem was relatively minor, requiring extension of the main cutoff grout curtain deeper

Field 08-ENGINEERING WORKS

Group 8E-Rock Mechanics and Geology

into both abutments. Abutment rock was pinned to assure stability and to prevent rockfalls. Shale seams in the keyway areas were treated by placing concrete cutoff walls in the shale beds at the heel and toe of the dam. As the reservoir was filled for the first time, several small slumps occurred in slopes along the sides of the reservoirs. One movement of a large block of rock presented a potential hazard to boaters and is under careful observation. At the present time, the landslide areas are not considered hazardous. (USBR)

THE PROBLEMS ON TUNNEL EXPLORATION,

Bureau of Reclamation, Denver, Colo.

Charles E. Hall.

Proc 7th Annu Eng Geol Soils Eng Symp, p 3-8, Moscow, Idaho, Apr 1969. 6 p.

Descriptors: *Engineering geology, Geologic investigations, Subsurface investigations, *Tunnels, Tunnel construction, Tunneling machines, Bids, Tunnel design, *Geologic mapping, Geologic control, Geophysics, Contract administration, Claims (Contracts), Exploration, Reconnaissance surveys, Helicopters, Alinements.

Geologic defects, Geophysical Identifiers: prospecting, Seismic refraction.

In recent tunnel projects, design engineers have been requesting detailed geologic information and interpretation of the effects of geologic structure on construction. Bureau of Reclamation programs now call for surface geologic mapping on a scale of 2000 ft to the inch for 4 or 5 mi either side of the alinement, and detailed mapping along the alinement on a scale of 400 ft to the inch. Field mapping is best performed on aerial photographs and then projected to either a planimetric base or a topographic base. Concentrating on engineering rock properties to place the engineering characteristics of a particular rock directly on the geologic map is most desirable, rather than to concentrate on classical geologic properties and names of formations. Detailed alinement mapping is followed by geophysical investigations and confirmed by drilling wherever time, money, and access permit. Access problems on tunnel investigations in relatively inaccessible areas are discussed, and experiences with helicopters are cited. When exploration and design are completed, there is the problem of what to put into the gidding documents for potential bidders; a private opinion is given that owners should provide the factual information and the geological interpretations upon which the design is based. (USBR) $W70\mbox{-}03792$

ROCK CUTTING RESEARCH FOR THE DESIGN AND OPERATION OF TUNNELLING MACHINES,

Newcastle-upon-Tyne Univ. (England).

F. F. Roxborough.

Tunnels Tunnelling, Vol 1, No 3, p 125-128, Sept-Oct 1969. 4 p, 8 fig, 8 ref.

Descriptors: Tunnel construction. mechanics, Mining engineering, *Rock excavation, Construction, *Tunneling machines, Experimental data, Compressive strength, Mechanical properties, Research and development, Temperature, Water cooling, *Foreign research, Test procedures, Cutting, Instrumentation, Rocks. Identifiers: Rock density, Great Britain, Tool design, Test results.

The need for machines capable of driving tunnels in rock has long been recognized by mining en-

gineers. The ease with which coal shearing machines are able to cut through rock intrusions encouraged engineers to explore the possibility of applying the same milling principle to rock cutting machines. Most mechanical rock cutting techniques require the penetration of a wedge into a rock surface, chipping fragments having volumes exceeding that of the tool or wedge. Rock cutting research has lagged behind machine development and application. The untenable situation exists in which machines are being further developed without any appreciation of rock cutting mechanics. Knowledge of the performance characteristics of a cutting tool in rock is essential in designing an efficient cutting system. The University of Newcastle upon Tyne, Great Britain, is undertaking research into the mechanical durability of tool materials for operation in a wide range of rock types from quartz-free limestones to granite. A simple method for assessing the machineability of rock is presented. The principles of full face cutting and of peripheral drum cutting are discussed (USBR) W70-03793

A MATHEMATICAL MODEL FOR PIT SLOPE STABILITY.

Arizona Univ., Tucson.

D. J. Hammel.

Ouart Colo Sch Mines, Vol 64, No 3, p 53-69, July 1969. 17 p, 11 fig, 4 tab, 1 ref.

Descriptors: Rock mechanics, Engineering geology, *Rockslides, Slopes, Rock excavation, *Slope stability, Quarries, *Quarrying, Mathematical analysis, *Pits, Cut slopes, Regression analysis, Statistical analysis, Correlation analysis, Correlation techniques, Mathematical models.

Identifiers: *Rock slope stability, Variables, Open pit mining.

When a clope failure occurs in construction and mining industries, an engineer is usually called in to determine the cause of the slide. To prevent damages and loss of life from rock slides, rock slope movement must be analyzed prior to failure. A method is given for determining the variables that affect slope movement in an unstable slope and the effect of these variables on slope movement. A sample application of the method is given for an open-pit copper mine in Arizona. First, a case history was developed for an unstable pit slope and then a statistical model of slope movement was developed by multiple correlation and regression analysis. Correlation coefficients were evaluated to select the statistically significant independent variables. Regression analysis predicts slope movement from known values of the independent variables. The best equation for predicting slope movement contained terms for precipitation, mining rate at the toes of the slope, amount of water added to a leach dump near the slope, and water pumped from the pit. Predicted rates of slope movement agreed closely with actual measured values. The statistical model developed is applicable to this particular unstable slope. (USBR) W70-03794

8F. Concrete

FIELD AND LABORATORY STUDIES OF THE SULPHATE RESISTANCE ON CONCRETE, Portland Cement Association, Skokie, Ill.

G. J. Verbeck.

Portland Cement Ass Res Dep Bull 227, p 113-124, Apr 1967. 15 p, 9 fig, 3 tab, 4 ref.

Descriptors: *Portland cements, Cements, *Concrete mixes, Field tests, Concretes, *Concrete *Concrete mixes, Field tests, Concretes, *Concrete technology, Concrete testing, Air entrainment, Soil environment, Exposure, Environmental tests, *Durability, Deterioration, Sea water. Identifiers: *Sulfate-resisting cements, *Sulfate attack, Concrete deterioration, Cement chemistry, Cement content, Concrete properties.

Studies of the sulfate resistance of concrete, conducted by the Portland Cement Association, are ducted by the Portland Cement Performance in concrete and involve field exposure tests of concrete to sulfate soils and sea water. Field exposure in sulfate soils shows the importance of the tricalcium aluminate content of cement, and the cement content and air content of the concrete. Observed sulfate resistances are compared with the tricalcium aluminate content estimated by 4 different methods. Studies of concrete in warm sea water show that concrete made with cement having a calculated tricalcium aluminate content below 11.2% has performed without deterioration through 25 yr of exposure. High tricalcium aluminate contents may provide some benefit against corrosion of steel when concrete cover is minimal. (USBR) W70-03796

8G. Materials

FIELD TESTS OF ALUMINUM ORTHOTROPIC BRIDGE DECK,

Aluminum Co. of America, New Kensington, Pa. Alcoa Research Labs.

Maurice L. Sharp. Proc Amer Soc Civ Eng, J Struct Div, Vol 95, No ST11, p 2463-2476, Nov 1969, 14 p, 16 fig, 3 tab, 3 ref, append.

Descriptors: Aluminum, *Bridges, Deflection, *Field tests, Structural behavior, Loads (Forces), Plates, Static tests, Stress, Stress analysis, Structural members, Structural engineering, Testing,

Test procedures. Identifiers: *Orthotropic bridges, *Bridge decks, Dynamic response, Dynamic loads, Dynamic tests, Loading tests, Static behavior.

Field tests to determine stresses and deflections of an orthotropic aluminum bridge deck caused by a 20-ton truck load are presented. A typical deck panel having a 3/8-in.-thick polyester resin-silica sand wearing surface was instrumented with electrical resistance strain gages and dial gages. Stresses and deflections were determined for 18 different static positions of the truck on the panel. Test values were lower but generally in good agreement with those calculated by AISC design procedures. Dynamic stresses were evaluated for truck speeds up to 20 mph and were about the same as corresponding stresses caused by static load. No measurable vibration of the deck occurred white contract of the same as corresponding stresses caused by static load. load. No measurable vibration of the deck oc-curred during or after passage of the truck. Lack of significant dynamic effects possibly was caused by a relatively high natural frequency of the deck and damping characteristics of the polyester resin. Transverse stresses in the deck plate with the wear-ing surface were about 80% of values in a plate without the wearing surface (LISPR). without the wearing surface. (USBR) W70-03795

81. Fisheries Engineering

FISH AND GAME.

For primary bibliographic entry see Field 06E. W70-03776

SUBJECT INDEX

BIBLIOGRAPHY ON SOCIO-ECONOMIC ASPECTS OF WATER RESOURCES, W70-03714 06B AERATED LAGOONS
TEMPERATURE RELATIONSHIP IN AEROBIC TREATHENT AND DISPOSAL
OF PULP AND PAPER WASTES,
OSD ACETIC ACTD
FERMENTATION OF SPENT SULFITE LIQUOR FOR THE PRODUCTION OF
VOLATILE ACIDS,
W70-03921 PHOSPHATE REMOVAL AT BALTIMORE, MARYLAND, W70-03930 ACIDIFICATION
DIALYSIS SEPARATION OF SEWAGE SLUDGE DIGESTION,
W70-03929
05D AERIAL PHOTOGRAPHY COLOR PHOTOGRAPHS FOR WATER RESOURCES STUDIES, FERMENTATION OF SPENT SULFITE LIQUOR FOR THE PRODUCTION OF VOLATILE ACIDS, W70-03921 05D APPLICATIONS OF COLOR ABRIAL PHOTOGRAPHY TO WATER RESOURCES STUDIES, W70-03869 ACTIVATED CARRON PHYSICOCHEMICAL TREATMENT OF WASTEWATER, W70-03927 05D ABROBIC TREATHENT
DIPLOGASTERID AND RHABDITID NEMATODES IN A WASTEWATER
TREATHENT PLANT, ACTIVATED SLUDGE
TEMPERATURE RELATIONSHIP IN AEROBIC TREATMENT AND DISPOSAL
OF PULP AND PAPER WASTES,
W70-03720
05D A PRISOLS ASULE A NUMERICAL HODEL FOR THE HYDROLOGIC TRANSPORT OF RADIOACTIVE ABROSOLS FROM PRECIPITATION TO WATER SUPPLIES, W70-03698 GRAVITY THICKENERS FOR ACTIVATED SLUDGE, W70-03914 05D AIRPORTS LIGHT WATER AND PROTEIN FOAM. PHOSPHATE REMOVAL AT BALTIMORE, MARYLAND, W70-03813 030 ACTIVATED SLODGE TREATHENT
PHOSPHATE REMOVAL AT BALTIMORE, MARYLAND
W70-03930
05 SNOW ALBEDO HODIFICATION - A REVIEW OF LITERATURE, W70-03652 02C ALBEDO MODIFICATION SNOW ALBEDO MODIFICATION - A REVIEW OF LITERATURE, W70-03652 02C LIQUIDATOR FOR SEWER DISTRICTS IN CERTAIN COUNTIES. W70-03769 ALECTHOD FOR PREDICTING THE EFFECTS OF LIGHT INTENSITY ON ALCAL GROWTH AND PHOSPHOROUS ASSIMILATION, W70-03923 WISCONSIN FLOOD CONTROL. W70-03802 043 WATER ADMINISTRATION - A SUGGESTED INSTITUTIONAL MODEL, W70-04010 ANIONIC AND MONIONIC SURFACTANT SORPTION AND DEGRADATION BY ALGAE CULTURES, W70-03928 05D W70-04011 DISTRIBUTION, CHARACTERIZATION, AND NUTRITION OF MARINE MICROORGANISMS FROM THE ALGAE POLYSIPHONIA LANOSA AND ASCOPHYLLUM NODOSUM, #70-04012 THE PUTURE OF THE NORTH CAROLINA COASTAL AREA. REPORT OF AN ALGAL BLOOM IN VIET-NAM, W70-03969 ADMINISTRATIVE AGENCIES
DRAINAGE DISTRICTS (CONSTRUCTION OF IMPROVEMENTS). W70-03743 04A ALGAE, MAN, AND THE ENVIRONMENT. W70-03973 WATERS, DRAINS, AND LEVEES (DISTRICTS IN MORE THAN ONE COUNTY) . W70-03744 ONONDAGA LAKE, NEW YORK--AN UNUSUAL ALGAL ENVIRONMENT, #70-03974 CONSOLIDATION OF DRAINAGE DISTRICTS. W70-03762 C-14 UPTAKE AS A SENSITIVE HEASURE OF THE GROWTH OF ALGAL CULTURES, W70-03983 WATERSHED DISTRICTS. PACTORS INFLUENCING ALGAL PRODUCTIVITY IN DEER CREEK RESERVOIR, UTAH, W70-03986 02H WISCONSIN FLOOD CONTROL AGENCIES. W70-03789 048 WISCONSIN FLOOD CONTROL. W70-03802 CARBON SOURCES IN ALGAL POPULATIONS AND ALGAL COMMUNITY COSTS AND MAINTENANCE OF DRAINAGE DISTRICTS. ALKYL PHENOL POLYETHOXYLATE
ANIONIC AND MONIONIC SURPACTANT SORPTION AND DEGRADATION BY
ALGAE CULTURES,
W70-03928
05D SOIL AND WATER CONSERVATION DISTRICTS. LEASES OF FEDERAL RESERVOIR LANDS FOR RESORT PURPOSES. W70-04027 ALKYL POLYETHOXYLATE
ANIONIC AND MONIONIC SURFACTANT SORPTION AND DEGRADATION BY
ALGAE CULTURES,
W70-03928
05D WATER RESOURCES BOARD. ALLOCHTHONOUS PHOSPHATES

AVAILABILITY OF MUD PHOSPHATES FOR THE GROWTH OF ALGAE,

W70-03955

OSC ADMINISTRATIVE ARRANGEMENTS FOR WATER RESOURCES DEVELOPMENT IN MONTANA, 970-04044 06E ALLUVIUM
DETERMINING SPECIFIC YIELD OF THE OGALLALA AQUIPER BY THE NEUTRON METHOD,
W70-03871
02F ADMINISTRATIVE DECISIONS

DELTA AND PINE LAND CO OF MISSISSIPPI V BOARD OF SUPERVISORS

OF BOLIVAR COUNTY (LEASING OF LEVEE DISTRICTS LAND)

W70-03907

O4A ALLUVIUM LANDS
DELTA AND PINE LAND CO OF MISSISSIPPI Y BOARD OF SUPERVISORS
OF BOLIVAR COUNTY (LEASING OF LEVEE DISTRICTS LAND).

04A ADMIRALTY

KOMMANVITTSELSKAPET HARWI V UNITED STATES (ACTION AGAINST PEDERAL GOVERNMENT FOR ALLEGED PAILURE TO MAINTAIN CHANNEL). W70-03766 AMINO ACIDS

UPTAKE OF GLICINE BY BLUE-GREEN ALGAE,

W70-03958

05C ADSORPTION
PHYSICOCHEMICAL TREATMENT OF WASTEWATER,
W70-03927 05D ANAEROBIC
DIALYSIS SEPARATION OF SEWAGE SLUDGE DIGESTION,
W70-03929 05D ADVANCED WASTE TREATHENT PHYSICOCREMICAL TREATHENT OF WASTEWATER, W70-03927 05D

ANA-BED ANALOG MODELS
ELECTRICAL ANALOGUES AND DIGITAL COMPUTERS FOR ESTIMATING UNSATURATED WATER FLOW IN SOILS, w70-03882 02G ANALYTICAL TECHNIQUE
GAMMA-RAY SPECTROSCOPY AS A TOOL FOR A RAPID INVESTIGATION
OF DETRITIC CORES,
W70-03650
07B ANALYTICAL TECHNIQUES
THE INFRA-RED DETERMINATION OF QUARTZ IN SEDIMENTS AND SEDIMENTARY ROCKS,
W70-03678
07B REDUCTION OF ANNUAL RIVER FLOWS TO LONGER PERIODS (RUSSIAN), RUNOFF VOLUME AND HAXIMUM DISCHARGES OF SPRING PLOODS APPLIED TO THE UNSTUDIED RIVERS OF KALININGRADSK REGION BACTERIAL GROWTH RATE IN THE SEA DIRECT ANALYSIS BY THYMIOINE AUTORADIOGRAPHY, W70-03968 05C WITROGEN METABOLISM IN LAKES. I. MEASUREMENT OF NITROGEN FIXATION WITH W-15, W70-03970 02H ANIONIC MEMBRANES IMPROVED ANIONIC MEMBRANES FOR ELECTRODIALYSIS, W70-03666 03A ANISOTROPY
ANISOTROPIC PERMEABILITY OF FRACTURED MEDIA,
02P ANNEXATION OF OLD DRAINAGE DISTRICTS BY NEW DRAINAGE DISTRICTS. W70-03760 04a APPLICATION METHODS
AN EVALUATION OF THREE COEFFICIENTS AS A HEASURE OF UNIFORMITY OF WATER APPLICATION BY SPRINKLERS, AQUATIC AIGAE
AVAILABILITY OF MUD PHOSPHATES FOR THE GROWTH OF ALGAE,
W70-03955
05C AQUATIC ENVIRONMENT
SOME EFFECTS OF SHADE COVER ON STREAM TEMPERATURE IN
SOUTHFAST ALASKA,
W70-03819
05G TRACE ELEMENT MEASUREMENTS IN THE AQUATIC ENVIRONMENT, AOUATIC ENVIRONMENTS ONORDOGA LAKE, NEW YORK--AN UNUSUAL ALGAL ENVIRONMENT, W70-03974 05C PHYSIOLOGICAL ECOLOGY, W70-03978 05C AQUATIC MICROORGANISMS
EXCRETION OF DISSOLVED ORGANIC COMPOUNDS BY AQUATIC MACROPHITES,
B70-03951
05C AQUIFER CHARACTERISTICS
COMPILATION OF RESULTS OF AQUIFER TESTS IN TEXAS,
W70-03660 02F BADIOCARBON AGES OF GROUNDWATER IN AN ARID ZONE UNCONFINED 02F SELECTED ANALYTICAL METHODS FOR WELL AND AQUIPER EVALUATION, W70-03943 ADUTER TESTING
COMPILATION OF RESULTS OF AQUIFER TESTS IN TEXAS,
W70-03660 02F ADDIFERS
COMPILATION OF RESULTS OF AQUIFER TESTS IN TEXAS,
H70-03660
02F GEOLOGY AND GROUNDWATER RESOURCES OF OCEAN COUNTY, NEW UPCONING OF FRESH WATER-SEA WATER INTERFACE BELOW PUMPING WELLS, FIELD STUDY, W70-03677 04B

DETERMINING SPECIFIC YIELD OF THE OGALLALA AQUIPER BY THE AVAILABILITY OF GROUNDWATER IN WAYNE COUNTY, IOWA, N70-03879 DISTRIBUTION OF CHLORIDES IN AN IRRIGATED CITRUS ORCHARD, W70-03799

ARID NEVADA SOIL, W70-03801 LABORATORY TESTS OF SPRAYABLE BATERIALS FOR RUNOFF INDUCEMENT ON A LOESSIAL SOIL, W70-03804 02E FUNCTIONS FOR COTTON (GOSSIPIUM HIRSUTUM L.) PRODUCTION FROM IRRIGATION AND NITROGEN PERTILIZATION VARIABLES I. HIELD AND EVAPORAMSPIRATION, W70-038076 ROOTZONE SALT PROFILES AND ALFALPA GROWTH AS IMPLUENCED BY IRRIGATION WATER SALINITY AND LEACHING PRACTION, W70-03807 RUNOFF INDUCEMENT IN ARID LANDS, W70-03809 LARGE VOLUME - LONG DISTANCE PRESH WATER TRANSFERBAL AS AN ALTERNATE TO DESALINATION, W70-03810 06D HYDROLOGIC RECONNAISSANCE OF SKULL VALLEY, TOOLLE COURTY, INFILTRATION BATES AS AFFECTED BY DESERT VEGETATION, W70-03864 02G ARKANSAS RIVER FLOOD PLAIN INFORMATION, ARKANSAS RIVER, DODGE CITY, KANSAS. W70-03668 04A LARGE VOLUME - LONG DISTANCE FRESH WATER TRANSFERRAL AS AN ALTERNATE TO DESALINATION, W70-03810 06D ARTIFICIAL PRECIPITATION
SHAPING THE LAW OF WEATHER CONTROL,
W70-03719 ASCOPHYLLUM NODOSUM DISTRIBUTION, CHARACTERIZATION, AND MUTRITION OF MARINE MICROGRAMISMS FROM THE ALGAE POLYSIPHONIA LANOSA AND ASCOPHYLLUM NODOSUM, W70-03952 DRAINAGE AND LEVEE DISTRICTS. W70-03741 CORRECTION OF ERRORS IN ASSESSING DRAINAGE DISTRICT LANDS. W70-03742 WASTEWATER RATES AND SERVICE CHARGES IN GREAT BRITAIN, W70-03875 ATTENUATION
WATER-HANNER ATTENUATION WITH A TAPERED LINE,
W70-03785 08B AUTORADIOGRAPHY
BACTERIAL GROWTH RATE IN THE SEA DIRECT AWALYSIS BY
THYHIDIRE AUTORADIOGRAPHY, AXENIC CULTURES
ANIONIC AND HONIONIC SURFACTANT SORPTION AND DEGRADATION BY
ALGAE CULTURES,
W70-03928
05D BACTERIAL POPULATION OF HUNIFIED LAKES (IM RUSSIAM), U70-03948 THE BOLE OF PHOSPHATE-SOLUBLE BACTERIA IN THE ASSISTIATION OF ROCK PROSPHATE PHOSPHORUS UNDER CONDITIONS OF MONOBACTERIAL CULTURE (IN MUSSIAM), W70-03960 BACTERIAL GROWTH RATE IN THE SEA DIRECT ANALYSIS BY THYMIDINE AUTORADIOGRAPHY, W70-03968 BARRAGE THE WATER SUPPLY SYSTEM UP TO A.D. 2001, W70-03842 06C BAYES BETHODS
THE BAYES BETHODS OF STATISTICAL HYDROLOGY (FRENCH),
W70-03906
02A BEACHES
EOLIAM MICRORIDGES ON MODERN BEACHES AND A POSSIBLE AMCIENT EXAMPLE, W70-03661 TOWN OF PALH BEACH V CARTER (PROHIBITION OF SURFING RITHIN TOWN LIMITS FOUND CONSTITUTIONAL). 06E SUBMERGENCE EFFECTS ON A RHODE ISLAND BARRIER AND LAGOON AND INFERENCES ON MIGRATION OF BARRIERS, 021 BED LOAD MOBILE-BED PLUVIOLOGY, W70-03669

SOIL RESPIRATORY ACTIVITY AND ORGANIC MATTER DEPLETION IN AM

NEUTRON METHOD, W70-03871

	2000
BEDS ISLANDS AND ABANDONED RIVER BEDS. W70-03759	06E
BEER-LAMBERT LAW A METHOD FOR PREDICTING THE EFFECTS (ACGAL GROWTH AND PHOSPHOROUS ASSIMIL) W70-03923	OF LIGHT INTENSITY ON ATION, 05C
BENCH-SCALE STUDY GRAVITY THICKENERS FOR ACTIVATED SLUIW 70-03914	OGE, OSD
BEXAR COUNTY (TEX) FLOOD PLAIN INFORMATION, ROSILLO CREI	EK, BEXAR COUNTY, TEXAS.
BIBLIOGRAPHIES FRACTURE OF LAKE AND SEA ICF, W70-03651	02C
BIBLIOGRAPHY OF THE GROUNDWATER RESON THROUGH 1967, W70-03659	O2F
BIBLIOGRAPHY ON SOCIO-ECONOMIC ASPECT	ES OF WATER RESOURCES, 06B
MARTNE RADTOECOLOGY, W70-03956	05C
BIOASSAY IRON IN NATURAL WATERSITS CHARACTER AVAILABILITY AS DETERMINED WITH THE I W70-03954	
AVAILABILITY OF MUD PHOSPHATES FOR TH	HE GROWTH OF ALGAR, 05C
RTOCHEMICAL OXYGPW DEMAND TEMPERATURE RELATIONSHIP IN AEROBIC TO PULL AND PAPER WASTES, W70-03720	TREATMENT AND DISPOSAL
PHYSICOCHEMICAL TRRATMENT OF WASTEWAY W70-03927	
USE OF MATHEMATICAL MODELS IN WATER (CHAPTER III, W70-03933	
USES OF MATHEMATICAL MODELS IN WATER STUDIES CHAPTER IV, W70-03934	
TRICKLING PILTER MODEL DESIGN AND C	
BIOCHPHISTRY DIPL AND SEASONAL VARIATIONS IN PHYSI SPEED RIVER, ONTARIO,	
W70-03861 BIODEGRADATION	02K
BIODEGRADABILITY AND TREATABILITY OF HUNICIPAL WASTES, W70-03926	COMBINED NYLON AND
BTOLOGICAL COMMUNITIES A DISCUSSION OF NATURAL AND ABNORMAL W70-03966	DIATON COMMUNITIES, 05C
CARBON SOURCES IN ALGAL POPULATIONS E STRUCTURE, W70-04001	AND ALGAL COMMUNITY
BIOMASS	V3B
CONCEPTS OF EUTROPHICATION AND TROPHS	CC BIOLOGY, 02H
BIOSSAY RELATIVE TOXICITIES AND DISPERSING EV DISPERSING PRODUCTS, W70-03913	VALUATIONS OF ELEVEN OIL
BIOSTIMULATION BIOSTIMULATION AND TOXICITY CRITERIA DESIGN-PRESENT PRACTICE AND FUTURE 1 W70-03982	AND APPLICATIONS IN POSSIBILITIES, 068
BLOOM REPORT OF AN ALGAL BLOOM IN VIET-NAM, W70-03969	, 05c
BOATING REGULATIONS REGULATION OF FERRY OPERATIONS. W70-03739	06F
BOATS REGULATION OF FERRY OPERATIONS. W70-03739	06E
PFRRIES AND WHARVES. W70-03755	06E
HIGHWAYS, BRIDGES AND PERRIES (PRIVATING INPROVEMENTS).	TE AND LOCAL
	VVD

LEGAL ACTIONS RELATING TO WATERCRAFT. W70-03915 06E

```
BODY SIZE
RELATION BETWEEN FILTERING RATE, TEMPERATURE, AND BODY SIZE
IN FOUR SPECIES OF DAPHNIA,
W70-03957
05C
  SEWERAGE - WATER WORKS. W70-04025
                                                     05G
BOUNDARIES (PROPERTY)
BOUNDARIES (STATE).
   W70-03747
   ANNEXATION OF OLD DRAINAGE DISTRICTS BY NEW DRAINAGE
   DISTRICTS.
W70-03760
  CITY OF PORT RICHEY V ADAMEK (CONSTRUCTION OF A DOCK EXTENDING INTO A NAVIGABLE RIVER).
   W70-03763
  PARTITION WHEN LAND BOUNDED BY WATER. W70-03786
  BOUNDARIES BY WATERCOURSES. W70-04039
                                                    06E
BOUNDARY DISPUTES
  OUNDARY DISPUTES
PARTITION WHEN LAND BOUNDED BY WATER.
044
BRIDGE CONSTRUCTION WATERCOURSES (ALTERATION FOR BRIDGE CONSTRUCTION). W70-03738 044
  TENNESSEE-MISSOURI BRIDGE COMMISSION. W70-03752 06E
  MISSOURI--ILLINOIS BRIDGE COMMISSION. W70-03753
  MISSOURI-ILLINOIS-JEFFERSON-MONROE BRIDGE COMMISSION. W70-03754 \phantom{-}06e\phantom{+}
  FORDS AND PUBLIC BRIDGES (CLEARING OF FORDS AND BUILDING OF BRIDGES).

WYO-03773 06E
  HIGHWAYS, BRIDGES AND FERRIES (PRIVATE AND LOCAL IMPROVEMENTS). W70-03775 06B
BRIDGE DECKS
FIELD TESTS OF ALUMINUM ORTHOTROPIC BRIDGE DECK,
W70-03795 08G
   DISTRIBUTION OF CONCENTRATED LOADS ON ORTHOTROPIC BRIDGE
  DECKS,
W70-03798
BRIDGES WATERCOURSES (ALTERATION FOR BRIDGE CONSTRUCTION).
   ¥70-03738
  BRIDGES.
W70-03750
                                                    06E
   W70-03751
                                                    06R
  FORDS AND PUBLIC BRIDGES (CLEARING OF FORDS AND BUILDING OF BRIDGES). $\rm with 1000\,MeV
  HIGHWAYS, BRIDGES AND FERRIES (PRIVATE AND LOCAL IMPROVEMENTS). W70-03775 06E
   FIRLD TESTS OF ALUMINUM ORTHOTROPIC BRIDGE DECK,
   DISTRIBUTION OF CONCENTRATED LOADS ON ORTHOTROPIC BRIDGE
  DECKS,
#70-03798
                                                    08A
  BUBBLES
JET INDUCED CIRCULATION AND DIFFUSION,
W70-03734
08B
BUOYANCY
BEHAVIOR OF BUOYANT JET IN CALM PLUID,
W70-03724
08B
BUOYS
NAVIGATION (ERECTION OF AIDS TO NAVIGATION)
N70-03916
06E
BURNING WETTING AGENT TESTS. W70-03812
                                  03D
  LIGHT WATER AND PROTEIN FOAM. W70-03813
CALCIUM BASE LIQUORS
```

CAL-COM FERMENTATION OF SPENT SULFITE LIQUOR FOR THE PRODUCTION OF VOLATILE ACIDS, W70-03921 CALCIUM CARBONATE STABILITY OF CALCIUM CARBONATE POLYMORPHS IN WARM, SHALLOW CALIBRATIONS
DESIGN OF A NEUTRON SCATTERING WATER CONTENT GAGE FOR SOILS,
078 CALIPORNIA STATISTICAL EVALUATION OF SALINITY AND NITRATE CONTENT AND TRENDS DEWEATH URBAN AND AGRICULTURAL AREA-PRESNO, CANADA
AN EVALUATION OF THREE COEFFICIENTS AS A MEASURE OF UNIFORMITY OF WATER APPLICATION BY SPRINKLERS, W70-03803 03F DIEL AND SEASONAL VARIATIONS IN PHYSIOCHEMICAL LIMNOLOGY, SPEED RIVER, ONTARIO, W70-03861 CAPILLARY ACTION
INFILTRATION INDUCED SOIL INSTABILITIES,
W70-03648 02G CARBON SOURCES IN ALGAL POPULATIONS AND ALGAL COMMUNITY CARBON RADIOISOTOPES
RADIOCARBON DETERMINATIONS APPLIED TO GROUNDWATER HYDROLOGY,
02F RADIOCARBON AGES OF GROUNDWATER IN AN ARID ZONE UNCONFINED C-14 UPTAKE AS A SENSITIVE MEASURE OF THE GROWTH OF ALGAL CULTURES, W70-03983 CAST-IN-PLACE PILES
COMPARISON OF PILE LOAD-TPST-SKIN-PRICTION VALUES AND
LABORATORY STRENGTH TESTS,
080 CATALOG OF INFORMATION ON WATER DATA
CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX
TO GROUNDWATER STATIONS,
W70-03658 CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO AREAL INVESTIGATIONS AND MISCELLANEOUS ACTIVITIES, W70-03663

CENTRAL VALLEY
WATER RESOURCE DEVELOPMENT IN CALIFORNIA THE COMPARATIVE
EFFICIENCY OF LOCAL, STATE AND FEDERAL AGENCIES,
04A

CES PRODUCTION PUNCTION
A GENERALIZATION OF THE CES PRODUCTION FUNCTION,
W70-03829 06A

CHANNEL IMPROVEMENT THIRD CLASS CITIES. W70-04037

CHANNEL MORPHOLOGY
STATISTICAL CONSIDERATION IN RIVER MORPHOLOGY,
W70-03708 02E

CHANNELS
STOCHASTIC STUDY OF CHANNEL DISTRIBUTION IN RIVER BASINS, 970-03707 STATISTICAL CONSIDERATION IN RIVER NORPHOLOGY, W70-03708

KOMMANYITTSELSKAPET HARNI V UNITED STATES (ACTION AGAINST FEDERAL GOVERNMENT FOR ALLEGED FAILURE TO HAINTAIN CHANNEL). V70-03766

BOUNDARIES BY WATERCOURSES. W70-04039

CHEMICAL PRECIPITATION

'SALT-BISCUITS' - A SPECIAL GROWTH STRUCTURE OF NACL IN SALT
SPRIMENTS OF THE TUZ GOLU ("SALT LAKE"), TURKEY,
W70-03671

OZK

CHEMICAL PROCESSES
PRINCIPLES OF PRIMARY PRODUCTIVITY PHOTOSYNTHESIS UNDER
COMPLETELY NATURAL CONDITIONS,

CHEMICAL REHOVAL PHYSICOCHEMICAL TREATHENT OF WASTEWATER, W70-03927 05D

CHERNOZEMS HETHOUS FOR THE DETERMINATION OF HAXIMUH SHOW RESERVES IN THE HIVER BASINS OF THE CENTRAL CHERNOZEM (BLACK EARTH) BELT

(RUSSIAN), #70-03684

02J

CHLORELLA
A METHOD FOR PREDICTING THE EFFECTS OF LIGHT INTENSITY ON
ALGAL GROWTH AND PHOSPHOROUS ASSIMILATION,
05C

CRLORIDES
DISTRIBUTION OF CHLORIDES IN AN IRRIGATED CITRUS ORCHARD, W70-03799 03C

CIRCULATION
ON THERMALLY MAINTAINED CIRCULATION IN A CLOSED OCEAN BASIN,
021

JET INDUCED CIRCULATION AND DIFFUSION, 870-03734 088

CIRQUES
EROSION OF CIRQUES,
W70-03846

CITIES
CORPORATE POWERS (REGULATION OF WATER SUPPLY - FLOOD COMPROL).
W70-03685

SEWERS AND WATERWORKS. W70-03748

POWERS UNDER CITY MANAGER CHARTER. W70-03749

PUBLIC HEALTH (MUNICIPAL WATER SUPPLY). 970-04036 03D

THIRD CLASS CITIES. W70-04037

CITRUS FRUITS
DISTRIBUTION OF CHLORIDES IN AN IRRIGATED CITRUS ORCHARD, W70-03799 03C

CLARIFICATION
TUBE CLARIFICATION PROCESS, OPERATING EXPERIENCES, 470-03911
05D

CLASSIFICATION
THE CLASSIFICATION OF LAKES,
W70-03984

CLAY MEMBRANES
THERMO-OSMOSTS THROUGH COMPACTED SATURATED CLAY MEMBRANES, W70-03859
02G

CLINTON COUNTY (HICH)
PLOOD PLAIN INFORMATION, LOOKINGGLASS RIVER, CLINTON COUNTY,
MICHIGAN.
W70-03868
04A

CLOSED CONDUIT FLOW
SECTION V, FLOW IN STORM DRAIMS AND THEIR APPURTENANCES
SECTION VI, DESIGN OF CLOSED STORM DRAINAGE SYSTEM SECTION
VII, DESIGN OF OPEN CHANNELS.
W70-03817
08A

CLOSING WATER-HANNER ATTENUATION WITH A TAPERED LINE, W70-03785 08B

CLOUD SEEDING
HYDROLOGIC EFFECTS OF RAINFALL AUGHENTATION,
W70-03931
02A

COAGULATION
GRAVITY THICKENERS FOR ACTIVATED SLUDGE,
W70-03914
05D

COASTAL SHIPPING
A COST HODEL FOR COASTAL SHIPPING, A HORREGIAN BLAMPLE,
W70-03834
06B

COMMONITY STRUCTURE
A DISCUSSION OF WATURAL AND ABNORMAL DIATOR COMMONITIES,
W70-03966
05C

COMPACTION
GRAVITY THICKENERS FOR ACTIVATED SLUDGE,
W70-03914 05D

COMPARATIVE STUDIES
COMPARISON OF PILE LOAD-TEST-SKIN-FRICTION VALUES AND
LABORATORY STRENGTH TESTS,
E70-03781
08D

RELATION BETWEEN FILTERING RATE, TEMPERATURE, AND EODY SIZE IN FOUR SPECIES OF DAPHNIA, W70-03957 OSC

COMPENSATION
UNITED STATES V 967.905 ACRES OF LAND (CONDENNES DEMAND COMPENSATION FOR BARGES ON LAKE SURROUNDED BY CONDENNED LAND). W70-03765

GRAYSON V COMB'ES OF BOSSIER LEVEE DISTRICT (COMPENSATION FOR LANDOWNERS FOR LEVEE DISTRICT DAMAGES).

```
¥70-03947
```

COST MINIMIZATION
THE WATER SUPPLY SYSTEM UP TO A.D. 2001,
W70-03842 06C

ECONOMIC ANALYSIS IN WATER QUALITY MANAGEMENT, W70-04000

COST MODEL
A COST MODEL FOR COASTAL SHIPPING, A NORWEGIAN EXAMPLE,
06B

05D

STS INVESTMENT RETURNS BEFORE AND AFTER TAX, 06B

MAXIMUM PROSPECTIVE VALUE CRITERION, W70-03828

THE WATER SUPPLY SYSTEM UP TO A.D. 2001, W70-03842

RETURNS TO SCALE AND COST CURVES, W70-03844

A BREAKTHROUGH IN THE TRACER STUDIES OF SEDIMENTATION TANKS, W70-03922

DESIGN AND COST OF ION-EXCHANGE SOFTENING FOR A 50-MGD SEAWATER EVAPORATION PLANT, 03A

COST-BENEFIT ANALYSIS
BENEFIT-COST ANALYSIS A CRITERION FOR SOCIAL INVESTMENT,
W70-03999
06B

COST-BENEFIT RATIO
A COMPARATIVE ANALYSIS OF THE NET PRESENT VALUE AND THE
BENEFIT-COST RATIO AS MEASURES OF THE ECONOMIC DESIRABILITY OF INVESTMENTS, W70-03825

FUNCTIONS FOR COTTON (GOSSIPIUM HIRSUTUM L.) PRODUCTION FROM IRBIGATION AND NITROGEN PERTILIZATION VARIABLES II. YIELD COMPONENTS AND QUALITY CHARACTERISTICS, W70-03805

PUNCTIONS FOR COTTON (GOSSYPIUM HIRSUTUM L.) PRODUCTION FROM IRRIGATION AND MITROGEN PERTILIZATION VARIABLES I. YIELD AND EVAPOTRANSPIRATION,

COUNTY COURTS FORDS AND PUBLIC BRIDGES (CLEARING OF FORDS AND BUILDING OF

CRITICAL PERIOD ANALYSIS
USE OF THE CRITICAL PERIOD IN RESERVOIR ANALYSIS,
W70-03655
04A

CROP PRODUCTION
VIELD-PROTEIN RELATIONSHIPS IN WHEAT GRAIN, AS AFFECTED BY
NITROGEN AND WATER,
W70-03800
02G

CROP RESIDUES
SOIL BESPIRATORY ACTIVITY AND ORGANIC MATTER DEPLETION IN AN ARID NEVADA SOIL,
W70-03801 02g

CROP RESPONSE

PUNCTIONS FOR COTTON (GOSSYPIUM HIRSUTUM L.) PRODUCTION FROM IRRIGATION AND NITROGEN FERTILIZATION VARIABLES II. YIELD COMPONENTS AND QUALITY CHARACTERISTICS,

W70-03805 . 021

CRYSTALLINE ROCKS
THE USE OF A TRACER TEST TO VERIFY AN ESTIMATE OF THE
GROUNDWATPE VELOCITY IN PRACTURED CRYSTALLINE ROCK AT THE
SAVANNAH RIVER PLANT NEAR AIKEN, SOUTH CAROLINA, ¥70-03899

THE ROLE OF PHOSPHATE-SOLUBLE BACTERIA IN THE ASSIMILATION OF ROCK PHOSPHATE PHOSPHORUS UNDER CONDITIONS OF MONOBACTERIAL CULTURE (IN RUSSIAN), W70-03960 05C

C-14 UPTAKE AS A SENSITIVE MEASURE OF THE GROWTH OF ALGAL CULTURES, W70-03983 05C

SECTION VIII, DESIGN OF CULVERTS. W70-03818

CYANOPHYTA
UPTAKE OF GLYCINE BY BLUE-GREEN ALGAE,
05C

DAM FAILURE
PRE-EQUILIBRIUM OBSERVATIONS ON THE RECONSTRUCTED FLAGSTAFF
GULLY DAM,
W70-03782
08D

DAMAGES
SWAMP AND OVERPLOWED LANDS (RECLAMATION AND ASSESSMENT OF

COMPUTER PROGRAMS
DEVPLOPMENT OF MATHEMATICAL MODEL AND COMPUTER PROGRAM POR OPTIMIZATION OF VERTICAL TUBE EVAPORATOR SALINE WATER PLANTS,

CONCENTRATED LOADING
DISTRIBUTION OF CONCENTRATED LOADS ON ORTHOTROPIC BRIDGE DECKS, W70-03798

CONCENTRATORS
SURPACP SLICKS AS CONCENTRATORS OF PESTICIDES IN THE MARINE ENVIRONMENT,

CONCEPTS OF EUTROPHICATION AND TROPHIC BIOLOGY, W70-03959

FIELD AND LABORATORY STUDIES OF THE SULPHATE RESISTANCE ON

CONCRETE TECHNOLOGY
FIELD AND LABORATORY STUDIES OF THE SULPHATE RESISTANCE ON CONCRETE, W70-03796

CONDEMNATION
UNITED STATES V 967.405 ACRES OF LAND (CONDEMNES DEMAND
COMPENSATION FOR BARGES ON LAKE SURROUNDED BY CONDEMNED LAND) . W70-03765

ESTABLISHMENT OF FREE FFRRIES. #70-03774 CONFERENCES
ALGAR, MAN, AND THE ENVIRONMENT.
W70-03973

EUTROPHICATION CAUSES, CONSEQUENCES, CORRECTIVES. W70-03975

CONSERVATION PUBLIC PARKS, FORESTS AND RECREATION. M70-03746 03D

MISSOURI PEDERAL WATER PROJECTS RECREATION FUND. W70~03771

CONSUMPTION
ON INDEPENDENCE POSTULATES CONCERNING CHOICE, W70-03832

PRODUCTION, CONSUMPTION, AND EXTERNALITIES,

CONSUMPTIVE USE PLONTIDA'S LAKES (RIGHTS ATTRIBUTABLE TO NAVIGABLE LAKES), W70-04017

FLORTDA'S LAKES (RIGHTS OF COMMERCIAL USERS),

CONTINENTAL SHELP
THE TIDELANDS CONTROVERSY AND LOUISIANA'S EXPERIENCE IN THE
DISPUTE,
#70-03689
06E

CONTRACTS SWAMP AND OVERFLOWED LANDS (PATENTS AND CONTRACTS). W70-03757 044

CONVECTION NOTES ON THE THEORY OF THE THERMOCLINE, W70-03726 02L

UNIFIED VIEW OF DIPPUSION AND DISPERSION W70-03729

COOLING WATER SOURCES FOR POWER GENERATION, W70-03727 05D

COOLING TOWERS
COOLING WATER SOURCES FOR POWER GENERATION,

COORDINATION
WISCONSIN PLOOD CONTROL AGENCIES.
W70-03789

CORPORATIONS
INVESTMENT PETURNS BEFORE AND AFTER TAX, W70-03827 068

CORRELATION ANALYSIS

A PRINCIPAL COMPONENT ANALYSIS OF SURPACE RUNOFF DATA FROM A NEW ZEALAND ALPINE WATERSHED, #70-03908

02E

EXTENSION OF PAINFALL RECORDS BY INTERSTATION CORRELATION, $\ensuremath{\text{W}} 70-03932$

COST ALLOCATION TRICKLING FILTER MODEL DESIGN AND COST FACTORS,

```
DAM-DIP
```

LEGAL ACTIONS RELATING TO WATERCRAFT.

GFOLOGY OF FLAMING GORGE DAM AND RESERVOIR, 970-03791

RELATION BETWEEN FILTERING RATE, TEMPERATURE, AND BODY SIZE IN POUR SPECIES OF DAPHNIA, W70-03957

DATA COLLECTIONS
CATALOG OF IMPORMATION ON WATER DATA, EDITION 1968 - INDEX
TO GROUNDWATER STATIONS,
02P

COMPILATION OF RESULTS OF AQUIFER TESTS IN TEXAS,

CAMALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO ARRAL INVESTIGATIONS AND MISCPLLANEOUS ACTIVITIES, #70-03663

DATA PROCESSING
ABOUT THE ANALYTICAL METHOD FOR THE COMPILATION OF THE WATER
BALANCE IN AGRICULTURE,
W70-03901
02D

DATA STORAGE AND RETRIEVAL
CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX
TO AREAL INVESTIGATIONS AND MISCELLANEOUS ACTIVITYPS,
W70-03663 02E

DECISION MAKING
LIQUIDATOR FOR SEWER DISTRICTS IN CERTAIN COUNTIES.
W70-03769
05G

COPING WITH UNCEPTAINTY IN THE MAKE OF BUY DECISION, W70-03826 068

USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES CHAPTER III, #70-03933

COST, PRECISION, AND VALUE RELATIONSHIPS OF DATA COLLECTION AND DESIGN ACTIVITIES IN WATER DEVELOPMENT PLANNING, \$70-0393

RESERVOTE SYSTEM DESIGN OPTIMIZATION, W70-03941

STRATEGY FOR MICHIGAN WATER RESOURCES MANAGEMENT APPROACH,

THRORTPS OF DECISION-MAKING IN ECONOMICS AND REHAVIORAL SCIENCE, W70-03991 068

DEER CREEK RESERVOIR (TTAH)
PACTORS INPLUENCING ALGAL PRODUCTIVITY IN DEER CREEK
PESERVOIR, UTAH,
PERENTOIR, UTAH,

DEHYDROGENASE
TEMPERATURE PEFECTS ON ENERGY OXYGEN REQUIREMENTS IN
BIOLOGICAL OXIDATION,
W70-03919
05D

DEMAND
THE WATER SUPPLY SYSTEM UP TO A.D. 2001, W70-03842

DEMINIPRALIZATION
THERMO-ECONOMICS OF SALINE WATER CONVERSION,
H70-03935 03A

DENSITY
HOTION OF THO DIMERSIONAL STARTING PLUME,
#70-03731 OBB

DENSITY CURRENTS
NUMBERICAL SIMULATION OF WITHDRAWAL FROM A STRATIFIED RESPRYOTE,
W70-03716
O88

DESALINATION COSTS
OPERATION OF SEA WATER DISTILLATION PLANTS,
W70-03657
03A

DESALTMATION PLANTS
OPERATION OF SEA WATER DISTILLATION PLANTS,
W70-03657
03A

DEVPLOPMENT OF NATHENATICAL HODEL AND COMPUTER PROGRAM FOR OPTIMIZATION OF VERTICAL TURE EVAPORATOR SALINE WATER PLANTS, 970-03665

DESALINATION PROCESS
IMPROVED AMIONIC MEMBRANES FOR ELECTRODIALYSIS,
W70-03666 03A

DRSALTNATION PROCESSES
DEVELOPMENT OF MATHEMATICAL MODEL AND COMPUTER PROGRAM FOR
OPTIMIZATION OF VERTICAL TUBE EVAPORATOR SALINE WATER
PLANTS, W70-03665

RESEARCH AND DEVELOPMENT ON LOW PRESSURE REVERSE OSMOSIS
MEMBERNES AND DESIGN OF A SHALL UNIT FOR BRACKISH WATER,
W70-03667 03A

TECHNOLOGY OF SEA WATER DESALINATION, W70-03946 03A

DESIGN
TUBE CLARIFICATION PROCESS, OPERATING EXPERIENCES, W70-03911
05D

A BREAKTHROUGH IN THE TRACER STUDIES OF SEDIMENTATION TANKS, W70-03922 05D

DESIGN AND COST OF ION-EXCHANGE SOFTENING FOR A 50-MGD SEA-WATER EVAPORATION PLANT, 03A

TRICKLING PILTER MODEL DESIGN AND COST FACTORS, W70-03947

DESIGN APPLICATIONS
BIOSTINULATION AND TOXICITY CRITERIA AND APPLICATIONS IN
DESIGN--PRESENT PRACTICE AND FUTURE POSSIBILITIES,
068

DESIGN CRITERIA

DRAINAGE MASTER PLAN FOR THE CITY OF FORT WORTH PUBLIC WORKS
DEPARTMENT, STORM DRAINAGE CRITERIA AND DESIGN MANUAL.

08a

SECTION I, INTRODUCTION SECTION II, DETERMINATION OF DESIGN DISCHARGE SECTION IX, APPENDIX. U70-03815

SECTION V, FLOW IN STORM DRAINS AND THEIR APPURTEHANCES SECTION VI, DESIGN OF CLOSED STORM DRAINAGE SYSTEN SECTION VII, DESIGN OF OPEN CHANNELS. 870-03817

SECTION VIII, DESIGN OF CULVERTS. W70-03818

BIOSTIMULATION AND TOXICITY CRITERIA AND APPLICATIONS IN DESIGN-PRESENT PRACTICE AND FUTURE POSSIBILITIES, W70-07482

DETENTION TIME A BREAKTHROUGH IN THE TRACER STUDIES OF SEDIMENTATION TANKS, $\psi 70-03922$

DETERGENTS
RX FOR AILING LAKES--A LOW PHOSPHATE DIET,
W70-03964 02H

DETRITUS
GAMMA-RAY SPECTROSCOPY AS A TOOL FOR A RAPID INVESTIGATION
OF DETRITIC CORES,
W70-03650
07B

DEUTERIUM
DOWNWARD MOVEMENT OF SOIL MOISTURE TRACED BY MEANS OF MYDROGEN ISOTOPES,
W70-03689
02G

CONTRIBUTION OF ISOTOPE TECHNIQUES TO THE STUDY OF SOME HYDROLOGICAL PROBLEMS, W70-03694 02A

APPLICATION OF DEUTERIUM ANALYSES TO THE HYDROLOGY OF THE LAKES OF THE GRAND COULSE, WASHINGTON, 02K

PRACTIONATION OF TRITIUM AND DEUTERIUM IS SOIL WATER, W70-03897

DEUTERIUM FRACTIONATION
PRACTIONATION OF TRITIUM AND DEUTERIUM IN SOIL WATER,
W70-03897 02G

DIALYSIS
DIALYSIS SEPARATION OF SEWAGE SLUDGE DIGESTION,
W70-03929
05D

DIALYSIS FERMENTATION TANK
DIALYSIS SEPARATION OF SEWAGE SLUDGE DIGESTION,
W70-03929 05D

DIATORS
A DISCUSSION OF NATURAL AND ABNORMAL DIATOR COMMUNITIES,
W70-03966
05C

DIETS
THE EFFECT OF DIETARY FAT ON THE HEAT TOLERANCE OF GOLDFISH (CARASSIUS AURATUS),
W70-03723
05C

DIFFUSION
DIFFUSIOPHORETIC AND THERMOPHORETIC EFFECTS ON PARTICULATE MATTER MEAR CONDENSING AND EVAPORATING WATER SURFACES,
028

NOTES ON THE THEORY OF THE THERMOCLINE, W70-03726 02L

DIFFUSION AND ENTRAINMENT IN TWO-LAYER PLOW, 970-03728

UNIFIED VIEW OF DIFFUSION AND DISPERSION, W70-03729

SUBJECT INDEX

JET INDUCED CIRCULATION AND DIFFUSION, W70-03734 08B DIGITAL COMPUTER W70+04009 DIGITAL COMPUTERS

RIFCTRICAL ANALOGUES AND DIGITAL COMPUTERS FOR ESTIMATING

UNSATURATED WATER PLOW IN SOILS,

0.26 DIMENSIONAL ANALYSIS
MOTION OF TWO DIMENSIONAL STARTING PLUMP,
W70-03731 DIPLOGASTERID
DIPLOGASTERID AND RHABBITID NEMATODES IN A WASTEWATER
TREATHFUT PLANT,
W70-03925
05D DIRECT RUNOPP

DETERMINING AND MAPPING THE AVERAGE HYDROLOGIC RESPONSE OF EASTERN UNITED STATES, W70-04008

07C DISCHARGE MEASUREMENT
AN ERROR MODEL FOR A SINGLE DISCHARGE MEASUREMENT, W70-03700 02E DISCHARGE (WATER)
REPUCTION OF ANNUAL RIVER PLOWS TO LONGER PERIODS (RUSSIAN),
W70-03681
02E CALCULATION OF MAXIMUM DISCHARGES OF CRIMEAN RIVERS (RUSSTAN) , W70-03682 RUNOPP VOLUME AND MAXIMUM DISCHARGES OF SPRING PLOODS APPLIED TO THE UNSTUDIED RIVERS OF KALININGRADSK REGION AN ERROR MODEL FOR A SINGLE DISCHARGE MEASUREMENT, W70-03700 02E RFLATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL DISPERSING PRODUCTS, UNIFIED VIEW OF DIFFUSION AND DISPERSION, RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL DISPERSING PRODUCTS, W70-03913 A BREAKTHROUGH IN THE TRACER STUDIES OF SEDIMENTATION TANKS, DISSOLVED OXYGEN COMPARTSON STUDTES OF WINKLER VS. OXYGEN SENSOR, W70-03876 05A USES OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES CHAPTER IV, W70-03934 058 DISSOLVED SOLIDS

COMMUNITIES OF OVER 1,000 POPULATION WITH WATER CONTAINING
IN EXCESS OF 1,000 PPM OF TOTAL DISSOLVED SOLIDS,

0.7C MECHANICS OF THE MOVEMENT OF HOISTURE AND CHEMICAL SUBSTANCES IN SOILS, W70-03881 02G DISTILLATION PRACTIONATION OF TRITIUM AND DEUTERIUM IN SOIL WATER, \$70-03897DISTRIBUTION, CHARACTERIZATION, AND NUTRITION OF MARINE HICROGRANISMS FROM THE ALGAE POLYSIPHONIA LANGSA AND ASCOPHYLLIM NODOSUM, W70-03952 05C

DITENAL
DITE AND SEASONAL VARIATIONS IN PHYSIOCHEMICAL LIMNOLOGY,
SPEED RIVER, ONTARIO,
W70-03861
02K DOCKS
PERFIES AND WHARVES.
W70-03755 CITY OF POET RICHRY V ADAMEK (CONSTRUCTION OF A DOCK EXTENDING INTO A WAVIGABLE RIVER). DOCUMENTATION

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX
TO GROUNDWATER STATIONS, CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO AREAL INVESTIGATIONS AND MISCELLAMEOUS ACTIVITIES, W70-03663 02E

DOWNWARD SOIL MOISTURE MOVEMENT
DOWNWARD MOVEMENT OF SOIL MOISTURE TRACED BY MEANS OF
HYDROGEN ISOTOPES, W70-03689 DRAINAGE DRAINS, DRAINAGE PROCREDINGS, AND DRAINAGE DISTRICTS. W70-03920 DRAINAGE DISTRICTS
DRAINAGE AND LEVEE DISTRICTS. 04A CORRECTION OF ERRORS IN ASSESSING DRAINAGE DISTRICT LANDS. DRAINAGE DISTRICTS (CONSTRUCTION OF IMPROVEMENTS). 970-03743 ANNEXATION OF OLD DRAINAGE DISTRICTS BY NEW DRAINAGE DRAINAGE DISTRICTS FOR MINING PURPOSES W70-03761 CONSOLIDATION OF DRAINAGE DISTRICTS. SANITARY DRAINAGE DISTRICTS-CITIES OVER 300,000 INHABITANTS AND ADJOINING COUNTIES. W70-03768 056 COSTS AND MAINTENANCE OF DRAINAGE DISTRICTS. $\ensuremath{\text{W70-03912}}$ DRAINS, DRAINAGE PROCEEDINGS, AND DRAINAGE DISTRICTS. W70-03920 DRAINAGE DISTRICTS OBGANIZED IN COUNTY COURT. $\ensuremath{\mathtt{W70-04020}}$ DRAINAGE ENGINEERING DRAINAGE DISTRICTS (CONSTRUCTION OF IMPROVEMENTS). W70-03743 044 DRAINAGE MASTER PLAN FOR THE CITY OF FORT WORTH PUBLIC WORKS DEPARTMENT, STORM DRAINAGE CRITERIA AND DESIGN MANUAL. W70-03814 SECTION I, INTRODUCTION SECTION II, DETERMINATION OF DESIGN DISCHARGE SECTION IX, APPENDIX. W70-03815 SECTION III, PLOW IN GUTTERS SECTION IV, STORM DRAIN INLETS. SECTION V, PLOW IN STORM DRAINS AND THEIR APPURTENANCES SECTION VI, DESIGN OF CLOSED STORM DRAINAGE SYSTEM SECTION VII, DESIGN OF OPEN CHANNELS.
W70-03817
ORA SECTION VIII, DESIGN OF CULVERTS. W70-03818 DRAINAGE MASTER PLAN
DBAINAGE MASTER PLAN FOR THE CITY OF FORT WORTH PUBLIC WORKS
DEPARTMENT, STORM DRAINAGE CRITERIA AND DESIGN MANUAL.
088 SECTION I, INTRODUCTION SECTION II, DETERMINATION OF DESIGN DISCHARGE SECTION IX, APPENDIX. 08A DRAINAGE PATTERNS (GEOLOGIC)
COMPARISON OF SMART AND SCHEIDEGGER STREAM LENGTH MODELS, CONSTRAINED RANDOM WALK HEANDER GENERATION, W70-03866 028 DISTRIBUTION OF INTERIOR LINK LENGTHS IN NATURAL CHANNEL DRAINAGE PRACTICES
WATERS, DRAINS, AND LEVEES (DISTRICTS IN MORE THAN ONE COUNTY).
W70-03744
04A DRAINAGE MASTER PLAN FOR THE CITY OF FORT WORTH PUBLIC WORKS DEPARTMENT, STORM DRAINAGE CRITERIA AND DESIGN MANUAL. W70-03814

DRAINAGE PROGRAMS
DRAINAGE MASTER PLAN FOR THE CITY OF FORT WORTH PUBLIC WORKS
DEPARTMENT, STORM DRAINAGE CRITERIA AND DESIGN MANUAL.
W70-03814
08A

DRAINAGE SYSTEMS DESIGN
SECTION V, FLOW IN STORM DRAINS AND THEIR APPURTENANCES
SECTION VI, DESIGN OF CLOSED STORM DRAINAGE SYSTEM SECTION
VII, DESIGN OF OPEN CHANNELS.
W70-03817 . 08A

DRA-ERO DRAINAGE WATER ROOTLES AND ALFALFA GROWTH AS INFLUENCED BY IRBIGATION WATER SALINITY AND LEACHING FRACTION, DRAINS
SECTION VIIT, DESIGN OF CULVERTS.
W70-03818 DRAINS, DRAINAGE PROCEEDINGS, AND DRAINAGE DISTRICTS. W70-03920 04A DROUGHTS
ESTIMATION OF THE PARAMETERS OF GUMBEL'S THIRD ASYMPTOTIC DISTRIBUTION BY DIFFERENT METHODS,
W70-03674
07C APPLICATION OF RUNS TO HYDROLOGIC DROUGHTS, \$270-03909 PIELD AND LABORATORY STUDIES OF THE SULPHATE RESISTANCE ON DUTCH LAKES

AVAILABILITY OF HDD PHOSPHATES FOR THE GROWTH OF ALGAE,

W70-03955

OSC DYNAMIC PROGRAMMING THE DYNAMIC PROGRAMMING APPROACH TO WATER-RESOURCES DEVELOPMENT, W70-03826 06B PESERVOIR SYSTEM DESTGN OPTIMIZATION, W70-03941 04A DYSTROPHIC BACTERIAL POPULATION OF HUMTPIED LAKES (IN RUSSIAN), EARTH DAMS
PRE-EQUILIRPIUM OBSERVATIONS ON THE RECONSTRUCTED PLAGSTAPP GULLY DAM,
W70-03782
08D OLOGY OF YEASTS FROM LAKE CHAMPLAIN, W70-03962 PRODUCTION, CONSUMPTION, AND EXTPRNALITIES, W70-03843 06B ECONOMIC ANALYSIS IN WATER QUALITY MANAGEMENT, \$70-04000 PCONOMIC FFFICIENCY
WATER FOR WESTERN FEDERAL IRRIGATION PROJECTS,
W70-03996 03F WATER RESOURCE DEVELOPMENT IN CALIFORNIA THE CO EFFICIENCY OF LOCAL, STATE AND PEDERAL AGENCIES, W70-03997 04A THE COMPARATIVE ECONOMIC EVALUATION ON INDEPENDENCE POSTULATES CONCERNING CHOICE, W70-03832 06B BENEFIT-COST ANALYSIS A CRITERION FOR SOCTAL INVESTMENT, W70-03999 06B PCONOMIC FRASIBILITY
THE WATER SUPPLY SYSTEM UP TO A.D. 2001,
W70-03842 06C THE DYNAMIC PROGRAMMING APPROACH TO WATER-RESOURCES DEVELOPMENT, PCONOMIC THPORY SURVEYS OF ECONOMIC THEORY, RESOURCE ALLOCATION, VOLUME III. W70-03990 06B ECONOMICS
BIBLIOGRAPHY ON SOCIO-ECONOMIC ASPECTS OF WATER RESOURCES,
06B HAXTHUM PROSPECTIVE VALUE CRITERION, W70-03828 068 THE DYNAMIC PROGRAMMING APPROACH TO WATER-RESOURCES THE OPTIMALITY OF LOCAL SUBSIDIES IN REGIONAL DEVELOPMENT PROGRAMS,
068 THP WATER-RPSOURCE COMMUNICATIONS GAP, W70-03841 THERMO-ECONOMICS OF SALINE WATER CONVERSION, THEORIES OF DECISION-MAKING IN ECONOMICS AND BEHAVIORAL SCIENCE, W70-03991

EDDY COEFFICIENT

ON THE ROLES OF VERTICAL VELOCITY AND EDDY CONDUCTIVITY IN MAINTAINING A THERMOCLINE, W70-03730 02L EPPECTIVE-AVERAGE-LIGHT-INTENSITY
A METHOD FOR PREDICTING THE EPPECTS OF LIGHT INTENSITY ON
ALGAL GROWTH AND PHOSPHOROUS ASSIMILATION, EPPICIPNCIES
OPERATION OF SEA WATER DISTILLATION PLANTS,
W70-03657 03A EFFICIENT ADMINISTRATIVE ARRANGEMENT
ADMINISTRATIVE ARRANGEMENTS FOR WATER RESOURCES DEVELOPMENT EFFLUENTS
DIPLOGASTERID AND BHABDITID NEMATODES IN A WASTEWATER
TREATHENT PLANT,
05D ELECTRIC GENERATORS

UNIT SPACING OF HYDROELECTRIC MACHINES,
W70-03783

08C ELECTRODIALYSIS
IMPROVED ANIONIC MEMBRANES FOR ELECTRODIALYSIS,
W70-03666 03A TECHNOLOGY OF SEA WATER DESALINATION, W70-03946 03A ELEVATION ELEVATION EPFECTS ON RAINFALL NEAR BOLLIS, ALASKA, W70-03820 02B PRIVATE SEWER SYSTEMS. W70-03736 UNITED STATES V 967.905 ACRES OF LAND (CONDEMNESS DEMAND COMPENSATION FOR BARGES ON LAKE SUPROUNDED BY CONDEMNED LAND) . W70-03765 GRAYSON V COMM'RS OF BOSSIER LEVEE DISTRICT (COMPENSATION POR LANDOWNERS FOR LEVEE DISTRICT DAMAGES). EMULSIFIERS
RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL DISPERSING PRODUCTS,
05C ENERGY BUDGET
EVAPORATION FROM LARGE DEEP LAKES,
W70-03717 ENERGY OXYGEN
TEMPERATURE EFFECTS ON EMERGY OXYGEN REQUIREMENTS IN
BJOLOGICAL OXIDATION,
W70-03919
05D ENGINEERING
HAXIMUM PROSPECTIVE VALUE CRITERION,
W70-03828 ENGINEERING GEOLOGY
TUNNELLING METHODS IN HUNGARY,
W70-03790 084 GEOLOGY OF FLAMING GORGE DAM AND RESERVOIR, N70-03791 THE PROBLEMS ON TUNNEL EXPLORATION, \$W70-03792088 PRGLAND
TRENT BASIN STOCHASTICS,
W70-03902 02R ENRICHMENT
THE RESPONSE OF NATURAL MICROBIAL POPULATIONS IN SEAWATER TO
ORGANIC ENRICHMENT,
W70-03967 ENTRAINMENT DIFFUSION AND ENTRAINMENT IN TWO-LAYER PLOW, W70-03728 08B PNVIRONMENTAL EFFECTS
PRINCIPLES OF PRIMARY PRODUCTIVITY
COMPLETELY MATURAL CONDITIONS, PHOTOSYNTHESIS UNDER ALGAE, MAN, AND THE ENVIRONMENT. W70-03973 ENZYME ACTIVITY
TEMPERATURE EFFECTS ON ENERGY OXYGEN REQUIREMENTS IN
BIOLOGICAL OXIDATION,
W70-03919
05D HOBILE-BED FLUVIOLOGY, W70-03669 023

SUBJECT INDEX EXTERNALITIES SUBMERGENCE EFFECTS ON A RHODE ISLAND BARRIER AND LAGOON AND INFERENCES ON MIGRATION OF BARRIERS, \$70-03845 PRODUCTION, CONSUMPTION, AND EXTERNALITIES, W70-03843 THE ECONOMICS OF AGRICULTURAL WATER USE, W70-03998 EROSION CONTROL SOIL AND WATER CONSERVATION DISTRICTS. W70-03918 EXTINGUISHING AGENTS
LIGHT WATER AND PROTEIN FOAM.
W70-03813 ERROR ANALYSIS
AN PEROR MODEL FOR A SINGLE DISCHARGE MEASUREMENT,
W70-03700 . 02E 030 FECAL COLIFORMS
RECLAIRED WASTEWATER FOR SANTEE RECREATIONAL LAKES, W70-03950 05D MINIMIZING NUCLEAR SOIL DENSITY AND MOISTURE CONTENT GAGE ERRORS, W70-03787 FECAL STREPTOCCOCI BLOOMS
RECLAIRED WASTEWATER FOR SANTEE RECREATIONAL LAKES, W70-03950 05D PEDERAL PROJECT POLICY
WATTONAL RIVERS AND HARBORS CONGRESS SUPPORTS A
COMPREHENSIVE WATER RESOURCES DEVELOPMENT PROGRAM,
06E THE FUTURE OF THE NORTH CAROLINA COASTAL AREA. EUTROPHICATION
CONSERVING RESOURCES AND MAINTAINING A QUALITY ENVIRONMENT,
W70-03823
058 PEDERAL RECLAMATION LAW SWAMP AND OVERFLOWED LAND. W70-03756 AVAILABILITY OF MUD PHOSPHATES FOR THE GROWTH OF ALGAE, FEDERAL SUBSIDIES
WATER FOR WESTERN FEDERAL IRRIGATION PROJECTS,
W70-03996 03F CONCEPTS OF EUTROPHICATION AND TROPHIC BIOLOGY, #70-03959 THE MYXOBACTERTA TYPE QUOTIPNT AS AN INDICATOR OF EUTROPHICATION FOR SURFACE WATERS (IN GERMAN), W70-03963 FENCES PARTITION WHEN LAND BOUNDED BY WATER. W70-03786 THE RESPONSE OF NATURAL MICROBIAL POPULATIONS IN SEAWATER TO ORGANIC EMPICHMENT, W70-03967 FERRENTATION OF SPENT SULFITE LIQUOR FOR THE PRODUCTION OF WOLATILE ACIDS, W70-03921 ALGAE, MAN, AND THE ENVIRONMENT. DTALYSIS SEPARATION OF SEWAGE SLUDGE DIGESTION, W70-03929 ONONDAGA LAKE, NEW YORK--AN UNUSUAL ALGAL ENVIRONMENT, W70-03974 PERRIES AND WHARVES. W70-03755 FUTROPHICATION CAUSES, CONSEQUENCES, CORRECTIVES. 06E ESTABLISHMENT OF FREE FERRIES. W70-03774 SOME POSSIBLE PHYSIOLOGICAL STRESSES INDUCED BY BUTROPHICATION, W70-03976 05C PERRIGRAM (HISTOGRAM)
IRON IN NATURAL WATERS---ITS CHARACTERISTICS AND BIOLOGICAL AVAILABILITY AS DETERBINED WITH THE PERRIGRAM, EVIDENCE FOR EUTROPHICATION FROM REMAINS OF ORGANISMS IN BIOSTIMULATION AND TOXICITY CRITPRIA AND APPLICATIONS IN DESIGN--PRESENT PRACTICE AND FUTURE POSSIBILITIES, W70-03982 HIGHWAYS, BRIDGES AND FERRIES (PRIVATE AND LOCAL IMPROVEMENTS).

W70-03775

06E EVALUATION AN ERROR MODEL POR A SINGLE DISCHARGE MEASUREMENT, W70-03700 02E NITRATE CONTENT OF THE UPPER RIO GRANDE AS INPLUENCED BY NITROGEN PERTILIZATION OF ADJACENT IRRIGATED LANDS, #70-03849 A METHOD FOR STATISTICAL EVALUATION OF WEATHER MODIFICATION AT THE RIVER FLOW CONTROL LEVEL, W70-03848 COMPARISON OF PILE LOAD-TEST-SKIN-PRICTION VALUES AND LABORATORY STRENGTH TESTS, EVAPORATION POTENTIAL EVAPORATION AS A MANIFESTATION OF REGIONAL EVAPORATION, 970-03676 02D W70-03781 FIELD TESTS OF ALUMINUM ORTHOTROPIC BRIDGE DECK, W70-03795 DIFFUSIOPHORETIC AND THERMOPHORETIC EFFECTS ON PARTICULATE MATTER NEAR CONDENSING AND EVAPORATING WATER SURFACES, W70-03691 028 PILTERING RATE
RELATION BETWEEN FILTERING RATE, TEMPERATURE, AND BODY SIZE
IN FOUR SPECIES OF DAPHNIA,
W70-03957
05C EVAPORATION FROM LARGE DEEP LAKES, W70-03717 02D BRIDGES. STOCHASTIC ASPECTS OF LAKE ONTARIO EVAPORATION, W70-03872 02D W70-03750 06E COSTS AND HAINTENANCE OF DRAINAGE DISTRICTS. 0.04EVAPORATION CONTROL
VAPOR LOSSES THROUGH SOIL MULCH AT DIFFERENT WIND
VELOCITIES,
WTO-03808
02G FINITE DIFFERENCES

COMPUTER STUDIES OF FINITE-AMPLITUDE WATER WAVES,

W70-04009

O7C EVAPOTRANSPIRATION

PUNCTIONS FOR COTTON (GOSSYPIUM HIRSUTUM L.) PRODUCTION FROM
IRRIGATION AND NITROGEN PERTILIZATION VARIABLES I. YIELD
AND EVAPOTRANSPIRATION,
W70-03806 . 021 WETTING AGENT TESTS. W70-03812 030 FIRE EXTINGUISHING
WETTING AGENT TESTS.
W70-03812 HYDROLOGIC RECONNAISSANCE OF SKULL VALLEY, TOOBLE COUNTY, 03D 02F LIGHT WATER AND PROTEIN FOAM. W70-03813 RELATIONSHIPS BETWEEN SOIL MOISTURE ACTUAL AND POTENTIAL EVAPORRANSPIRATION, 92D 92D 03D FIREFIGHTING WETTING AGENT TESTS. W70-03812 EXPERIMENTAL WATERSHEDS
SEDIMENT TIPLDS FROM THE CENTRAL COLORADO SNOW ZONE,
W70-03821
2J O 3D LIGHT WATER AND PROTEIN FOAM. W70-03813 EXPLOITATION
OCEAN MINERALS AND THE LAW,
W70-03822

06E

BIOLOGICAL EFFECTS OF HANFORD HEAT ON COLUMBIA RIVER FISHES.

FIS-FOU 05C W70-03721 FISH CONSERVATION FISH AND GAMP. **
#70-03776 OSE HUNTING AND FISHING REGULATIONS. W70-03777 PISH AND GAMP (THE WILDLIPE AND FORESTRY LAW). 970-04026PISH MANAGEMENT
FISH AND GAMF (THE WILDLIFE AND FORESTRY LAW).
W70-04026
06E PISHING FISH AND GAME. W70-03776 HUNTING AND FISHING REGULATIONS. PTXED-DENSITY STUDIES
A METHOD FOR PERDICTING THE EFFECTS OF LIGHT INTENSITY ON ALGAL GROWTH AND PHOSPHOROUS ASSIMILATION, 05c PTARD-LIGHT TESTS
A METHOD FOR PREDICTING THE EFFECTS OF LIGHT INTENSITY ON ALGAL GROWTH AND PHOSPHOROUS ASSIMILATION, 05C PLOOD CONTROL
HISCONSIN PLOOD CONTROL AGPNCIES.
W70-03789 WISCONSTN FLOOD CONTROL. W70-03802 DRAINAGE MASTER PLAN FOR THE CITY OF FORT WORTH PUBLIC WORKS DREARMENT, STORM DRAINAGE CRITERIA AND DESIGN MANUAL. W70-03814 FLOOD DANAGE
FLOOD PLAIN INFORMATION, ROSILLO CREEK, BEXAR COUNTY, TEXAS.
W70-03647 PLOOD PLAIN INFORMATION, ARKANSAS RIVER, DODGE CITY, KANSAS. W70-03668 PLOOD PLAIN INFORMATION, LOOKINGGLASS BIVER, CLINTON COUNTY, MICHIGAN. FLOOD FORFCASTING
A PEAK DISCHARGE RELATION FOR INTERMEDIATE DRAINAGE BASINS,
W70-03455
02E PURPOSE AND PERFORMANCE OF PEAK PREDICTIONS, N70-03887 PEFECTS OF SAMPLING INTERVAL, PERIODICITY, DEPENDENCE AND SKEWNESS ON EXTREMP VALUES, W70-03910 02F FLOOD PREOUPNCIPS
DETERMINATION OF OPTIMAL PLOOD PROTECTION LEVELS WITH SMALL EXCREDANCE PROBABILITIES,
061 PLOOD PLATMS
AN ACTIVITY ANALYSIS OF NON-STRUCTURAL PLAIN MANAGEMENT
ALTERNATIVES CHAPTER IV,
W70-04003
06F FLOOD PROTECTION

EPPECTS OF FLOOD PROTECTION ON LAND USE IN THE COON CREEK,
WISCONSIN, WATERSHED,

044 CORPORATE POWERS (REGULATION OF WATER SUPPLY - FLOOD CONTROL).
W70-01685 LEVER DISTRICTS. W70-04021 048 PLOGDING
DETERMINATION OF OPTIMAL PLOOD PROTECTION LEVELS WITH SMALL EXCEEDANCE PROBABILITIES, W70-03653
068

PLOODPROOPING
AN ACTIVITY ANALYSIS OF NON-STRUCTURAL PLAIN MANAGEMENT
ALTPRNATIVES CHAPTER IV,
W70-04003
06P

PLOODS

PLOOD PLATM IMPORMATION, ROSILLO CREEK, BEXAR COUNTY, TEXAS.

#70-03647

044

PLOOD PLAIN INFORMATION, ARKANSAS RIVER, DODGE CITY, KANSAS.

RUNOPP VOLUME AND MAXIMUM DISCHARGES OF SPRING PLOODS APPLIED TO THE UNSTUDIED RIVERS OF KALININGRADSK REGION (RUSSIAM), #70~03693

ON THE EXTREME VALUE DISTRIBUTION FOR DESCRIBING ANNUAL

02E

FLOOD PLAIN INFORMATION, LOOKINGGLASS RIVER, CLINTON COUNTY, MICHIGAN. W70-03868

PLORIDA PLORIDA S LAKES (PROBLEMS IN A WATER PARADISE), #70-04013 ... 06E

PLORIDA'S LAKES (NAVIGABILITY AND PUBLIC RIGHTS),

PLORIDA'S LAKES (TESTS OF NAVIGABILITY), W70-04015

PLORIDA'S LAKES (RIGHTS IN LAKES), W70-04016

FLORIDA'S LAKES (RIGHTS ATTRIBUTABLE TO NAVIGABLE LAKES), W70-04017

PLORIDA'S LAKES (RIGHTS OF THE PUBLIC), 870-04018

FLORIDA'S LARES (RIGHTS OF COMMERCIAL USERS), W70-04019 06E

FLOW AUGHENTATION SIMULATION MODEL FOR FLOW AUGMENTATION COSTS, W70-03940 05G

FLOW CHARACTERISTICS EVALUATION OF PLOW PARAMETERS, W70-03880 02G

PLOW PARAMETERS EVALUATION OF PLOW PARAMETERS, W70-03880

PLOW-THROUGH CURVE A BREAKTHROUGH IN THE TRACER STUDIES OF SEDIMENTATION TANKS, 05D

POAMING LIGHT WATER AND PROTEIN FOAM. W70-03813 03D

POAMING AGENTS
LIGHT WATER AND PROTEIN FOAM.
W70-03813

FONTANA RESERVOIR
ULTRA-LOW VELOCITY MEASUREMENT IN A STRATIFIED RESERVOIR BY
ISOTOPIC CURRENT METER,
W70-03697
02H

PORDS AND PUBLIC BRIDGES (CLEARING OF FORDS AND BUILDING OF BRIDGES).
W70-03773
06E

PORECASTING
ESTIMATION OF THE PARAMETERS OF GUMBEL'S THIRD ASYMPTOTIC
DISTRIBUTION BY DIFFERENT METHODS,
07C

AN ANALYSIS OF RUNS OF PRECIPITATION EVENTS, W70-03702

A HODEL FOR GENERATING SINTHETIC SEQUENCES OF SHORT-TIME-INTERVAL RAINFALL DEPTHS, 02B

BIOSTIMULATION AND TOXICITY CRITERIA AND APPLICATIONS IN DESIGN--PRESENT PRACTICE AND PUTURE POSSIBILITIES, W70-03982 068

FOREIGN RESEARCH
ROCK CUTTING RESEARCH FOR THE DESIGN AND OPERATION OF
TUNNELLING MACHINES,
ORE

PORT WORTH
DRAINAGE MASTER PLAN FOR THE CITY OF FORT WORTH PUBLIC WORKS
DEPARTMENT, STORN DRAINAGE CRITERIA AND DESIGN MANUAL.
W70-03814
08A

SECTION I, INTRODUCTION SECTION II, DETERMINATION OF DESIGN DISCHARGE SECTION IX, APPENDIX.

OBA

OBA

SECTION III, FLOW IN GUTTERS SECTION IV, STORM DEAIN INLETS. W70-03816 ORA

SECTION V, PLOW IN STORM DRAINS AND THEIR APPURTENANCES SECTION VI, DESIGN OF CLOSED STORM DRAINAGE SYSTEM SECTION VII, DRSIGN OF OPEN CHANNELS.
W70-03817

SECTION VIII, DESIGN OF CULVERTS. W70-03818

FOUNDATION INVESTIGATIONS
GEOLOGY OF FLAHING GORGE DAN AND RESERVOIR,
W70-03791 08E

POUNDATIONS
ON THE EFFECTIVENESS OF SAND DRAIMS,

FRACTURES (GEOLOGY)
ANISOTROPIC PERMEABILITY OF FRACTURED MEDIA,
W70-03870
02F

PRANCIS TURBINES
UNIT SPACING OF HYDROELECTRIC MACHINES,
W70-03783
08C

PREQUENCY ANALYSIS
DETERMINATION OF OPTIMAL PLOOD PROTECTION LEVELS WITH SMALL EXCEPDANCE PROBABILITIES, U.O.A. 0.6A

080

POINT RAINFALL PREQUENCIES IN CONVECTIVE STORMS, #70-03673

ON THP EXTREME VALUE DISTRIBUTION FOR DESCRIBING ANNUAL FLOOD SERIES, w70-03854 02E

THE BAYES METHODS OF STATISTICAL HYDROLOGY (FRENCH), W70-03906

FRESH WATER
TECHNOLOGY OF SEA WATER DESALINATION,
W70-03946 03A

PRICTION PILES
COMPARISON OF PILE LOAD-TEST-SKIN-PRICTION VALUES AND
LABORATORY STRENGTH TESTS,
W70-03781
ORD

PROST
WPATHER AND DIDRNAL PROZEN SOIL STRUCTURE AT CHARLOTTES VILLE, VIRGINIA,
W70-03863 - 02C

W70-03777 . 06R

GAMMA RAYS
GAMMA-RAY SPECTROSCOPY AS A TOOL FOR A RAPID INVESTIGATION OF DETRITIC CORPS, W70-03650 . 07B

GASIFICATION
DIALYSIS SEPARATION OF SPRAGE SLUDGE DIGESTION,
W70-03929
05D

GASTROPODS
STUDTES ON THE RESISTANCE OF MARINE BOTTOM INVERTEBRATES TO OXYGEN-DEPICIENCY AND HYDROGEN SULFIDE, W70-03971
OSC

GENERALIZED PRODUCTION PUNCTION
GENERALIZED PRODUCTION FUNCTIONS,
W70-03833

GENERALIZED WEBFR PROBLEM
AN EXTENSION OF THE GENERALIZED WEBFR PROBLEM,
W70-03840 06A

GEOGRAPHICAL ASSOCIATION
THE IMPACT OF INDUSTRIAL LINEAGES ON GEOGRAPHIC ASSOCIATION,
W70-03835
06B

GROLOGIC THVESTIGATIONS
GROLOGY OF FLAMING GORGE DAW AND RESERVOIR,
W70-03791 08E

GEOLOGIC MAPPING
THE PROBLEMS ON TUNNEL EXPLORATION,
W70-03792
08

GROMORPHOLOGY STOCHASTIC STODY OF CHANNEL DISTRIBUTION IN RIVER BASINS, W70-03707 02E

STATISTICAL CONSIDERATION IN RIVER MORPHOLOGY, W70-03708

GLACIERS EROSION OF CIRQUES, W70-03846

GLOSSARY OF DRAINAGE TERMS
SECTION I, INTRODUCTION SECTION II, DETERMINATION OF DESIGN
DISCHARGE SPCTION IX, APPENDIX.
W70-03815
08A

02.7

GLYCINE
UPTAKE OF GLYCINE BY BLUE-GREEN ALGAE,
W70-03958
05C

GOLDFISH
THE RELATION OF TEMPERATURE TO OXIGEN CONSUMPTION IN THE
GOLDFISH,
W70-03722

THE EFFECT OF DIETARY FAT ON THE HEAT TOLERANCE OF GOLDFISH
(CARASSIUS AURATUS),
W70-03723

GOVERNMENT
ON SUBSIDIES TO SPEED THE RATE AT WHICH TECHNOLOGIES ARE DEVELOPED,
W70-03830
OGB

GRABBLING
HUNTING AND PISHING REGULATIONS.

GRAND COULEE (WASH)
APPLICATION OF DEUTERIUM ANALYSES TO THE HYDROLOGY OF THE
LAKES OF THE GRAND COULEE, WASHINGTON,
02K

GRAZING
RELATION BETWEEN FILTERING RATF, TEMPERATURE, AND BODY SIZE
IN FOUR SPECIES OF DAPHNIA,
W70-03957

GREAT ENITAIN
WASTEWANTER RATES AND SERVICE CHARGES IN GREAT BRITAIN,
W70-03875
06E

HANAGEMENT OF INDUSTRIAL EFFLUENT DISPOSAL IN BRITAIN, W70-03877

GREAT LAKES

RX FOR AILING LAKES--A LOW PHOSPHATE DIET,
W70-03964 02H

GROUNDWATER
STATISTICAL EVALUATION OF SALINITY AND WITRATE CONTENT AND
TRENDS BENEATH URBAN AND AGRICULTURAL AREA-PRESNO,
CALIFORNIA,
170-03600

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO GROUNDWATER STATIONS, W70-03658 02P

BIBLIOGRAPHY OF THE GROUNDWATER RESOURCES OF NEW YORK THROUGH 1967, #70-03659 02F

GEOLOGY AND GROUNDWATER RESOURCES OF OCEAN COUNTY, NEW JERSEY, W70-03670 02P

FORMATION AND GEOLOGICAL ROLE OF GROUNDWATERS, W70-03679

HYDROLOGIC RECONNAISSANCE OF SKULL VALLEY, TOOLLE COUNTY, UTAH, #70-03811 02F

AVAILABILITY OF GROUNDWATER IN WAYNE COUNTY, IOWA, W70-03879

GROUNDWATER DATING
BADIOCARBON AGES OF GROUNDWATER IN AN ARID ZONE UNCONFINED
AQUIFER,
W70-03895

GROUNDWATER HYDROLOGY RADIOCARBON DETERMINATIONS APPLIED TO GROUNDWATER HYDROLOGY, \$70-03890 02F

GROUNDWATER MOVEMENT
RADIOCARBON DETERMINATIONS APPLIED TO GROUNDWATER HYDROLOGY,
W70-03890 02F

GROUNDWATER PLOW AND DIRECTION MEASUREMENT BY MEANS OF RADIOISOTOPES IN A SINGLE WELL, W70-03892 02P

USE OF CHEMICAL AND RADIOACTIVE TRACERS AT THE NATIONAL REACTOR TESTING STATION, IDAHO, W70-03893 02F

TECHNIQUES OF GROUNDWATER TRACING USING RADIONUCLIDES, W70-03896 02F

THE USE OF A TRACER TEST TO VERIFY AN ESTIMATE OF THE GROUNDWATER VELOCITY IN FRACTURED CRYSTALLINE ROCK AT THE SAVANNAH RIVER PLANT NEAR AIKEN, SOUTH CAROLINA, W70-03899

GROUNDWATER RECHARGE FORMATION AND GEOLOGICAL ROLE OF GROUNDWATERS, W70-03679 . 02F

THE EFFECT OF SOIL MOISTURE ON INFILTRATION AS BELATED TO RUMOFF AND RECHARGE, 470-03884 02G

GROUNDWATER TRACING
TECHNIQUES OF GROUNDWATER TRACING USING RADIONUCLIDES,
W70-03896 . 02F

GROWTH
C-14 UPTAKE AS A SENSITIVE MEASURE OF THE GROWTH OF ALGAL
CULTURES,
#70-03983
05C

GROWTH RATE
MAXIMUM PROSPECTIVE VALUE CRITERION,
W70-03828
06B

GROWTH RATES
GROWTH OF LARGEMOUTH BASS PRY AND VARIOUS TEMPERATURES, W70-03733

BACTERIAL GROWTH RATE IN THE SEA DIRECT ANALYSIS BY THYMIDINE AUTORADIOGRAPHY, W70-03968 05C

GUT-IND GUTTER FLOWS
DRAINAGE MASTER PLAN FOR THE CITY OF FORT WORTH PUBLIC WORKS
DEPARTMENT, STORM DRAINAGE CRITERIA AND DESIGN MANUAL.
08A SECTION III, PLOW IN GUTTEPS SECTION IV, STORM DRAIN INLETS. W70-03816 ¥70-03816 HEAT RALANCE AT RALANCE
NOTES ON THE THEORY OF THE THERMOCLINE,
02L ON THE ROLES OF VERTICAL VELOCITY AND EDDY CONDUCTIVITY IN NATUTALISTING A THEPROCLINE, 970-03730 02L HEAT RESISTANCE
THE EFFECT OF DIETARY FAT ON THE HEAT TOLERANCE OF GOLDFISH
(CARASSIUS AURATUS), HEATED WATER
EVAPORATIVE COOLING OF HEATED IRRIGATION WATER BY SPRINKLER
APPLICATION,
05D BIOLOGICAL EPPECTS OF HANFORD HEAT ON COLUMBIA RIVER PISHES A REVIEW, W70-03721 05C APPLICATION OF DEUTERIUM ANALYSES TO THE HYDROLOGY OF THE LAKES OF THE GRAND COULER, WASHINGTON, #70-0369 02K HIGHWAY CULVERT DESIGN
SECTION VIII, DESIGN OF CULVERTS.
W70-03818 HIGHWAY DRAINAGP SECTION VIII, DESIGN OF CULVERTS. W70-03818 084 HOUSEHOLD BRHAVIOR
RESFARCH ON HOUSEHOLD BRHAVIOR,
W70-03994 06 B HUMAN POPULATION
ALGAE, MAN, AND THE ENVIRONMENT.
W70-03973 BUMIPTCATION RACTERTAL POPULATION OF HUMIFIED LAKES (IN RUSSIAN), \$70-03948 O2H HURRICANF BETSY
HURRICANF TRITIUM I PRETININARY RESULTS ON HILDA 1964 AND
BETSY 1965,
W70-03693
02B HORRICANP HILDA
HORRICANP TRITIUM T PRPLIMINARY RESULTS ON HILDA 1964 AND
BETSY 1965,
W70-03693 02B HURRICARES
HURRICARE TRITIUM I PRELIMINARY RESULTS ON HYLDA 1964 AND RETSY 1965,
870-03693
028 HYDRAULIC DESIGN
SECTION V, FLOW IN STORM DRAINS AND THEIR APPURTENANCES
SECTION VI, DESIGN OF CLOSED STORM DRAINAGE SISTEM SECTION
VIT, DESIGN OF OPEN CHANNELS.
W70-03817 SECTION VIII, DESIGN OF CULVERTS. W70-03818 HYDRAULIC MODELS
THE DETERMINATION OF LOCAL INFLOWS EMTERING A CHANNEL, W70-03699

HYDRAULIC CONDUCTIVITY
PIELD MEASUREMENT AND USE OF SOIL-WATER PROPERTIES, W70-03675 02G

UNIPICATION OF DATA ON SEDIMENT TRANSPORT IN FLUHES BY STRILLTUDE PRINCIPLES, W70-03874

SINTLITUDE FOR PARTIALLY SATURATED FLOW SYSTEMS, N70-03883

HYDRAULIC SIMILITUDE UNIFICATION OF DATA ON SEDIMENT TRANSPORT IN FLUMES BY SIMILITUDE PRINCIPLES, BY0-03874 02J

HYDRAULIC STRUCTURES
SECTION III, PLOW IN GUTTERS SECTION IV, STORM DRAIN
INLETS.

HYDRAULIC TRANSPORTATION
BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN
DISPOSAL SITES VOLUME III - TECHNICAL ASPECTS OF
PIPPLINING OF WASTE HATERIALS,

W70-04007

HYDRAULIC TURBINES
UNIT SPACING OF HYDROELECTRIC MACHINES,
W70-03783
08C

HYDPAULICS
BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES VOLUME III - TECHNICAL ASPECTS OF PIPPLINTING OF WASTE MATERIALS, W70-04007 05E

HYDRAULICS MODELS
BPHAVIOR OF BUOYANT JET IN CALM FLUID,
W70-03724
08B

HYDROBLECTRIC PLANTS
UNIT SPACING OF HYDROBLECTRIC MACHINES,
08C W70-03783

HYDROGEOLOGY
FORMATION AND GEOLOGICAL ROLE OF GROUNDWATERS,
W70-03679
02F

HYDROLOGIC BUDGET

ABOUT THE AWALTTICAL METHOD FOR THE COMPILATION OF THE WATER BALANCE IN AGRICULTURE,
W70-03901

02D

SELECTED ANALYTICAL HETHODS FOR WELL AND AQUIFER EVALUATION, 970-03943 04B

HYDROLOGIC CYCLE
A NUMERICAL MODEL FOR THE HYDROLOGIC TRANSPORT OF
RADIOACTIVE AEROSOLS FROM PRECIPITATION TO WATER SUPPLIES,

02A

SUNSPOTS AND HYDROLOGIC TIME SERIES, W70-03712

WATER TRACING IN THE HYDROLOGIC CYCLE, W70-03900 02A

HYDROLOGIC DATA
CATALOG OF IMPORNATION ON MATER DATA, EDITION 1968 - INDEX
TO GROUNDWATER STATIONS,

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO AREAL INVESTIGATIONS AND MISCELLANBOUS ACTIVITIES, W70-03663

ABOUT THE ANALYTICAL SETHOD FOR THE COMPILATION OF THE WATER BALANCE IN AGRICULTURE, W70-03901 02D

EXTENSION OF RAINFALL RECORDS BY INTERSTATION CORRELATION, W70-03932

HYDROLOGIC MAPPING
DETERMINING AND MAPPING THE AVERAGE HYDROLOGIC BESPONSE OF PASTERN UNITED STATES,

HYDROLOGIC PROPERTIES

LARGE-SCALE UTILIZATION OF TRITION IN HYDROLOGIC STUDIES,
W70-03894

02A

DETERMINING AND WAPPING THE AVERAGE HYDROLOGIC BESPONSE OF EASTERN UNITED STATES, 870-04008 07C

RYDROLOGIC TIME SERIES
SUMSPOTS AND HYDROLOGIC TIME SERIES,
W70-03712

HYDROLOGY
SECTION I, INTRODUCTION SECTION II, DETERMINATION OF DESIGN
DISCHARGE SECTION IX, APPENDIX.
W70-03815

RYDROLOGIC EPPECTS OF RAINFALL AUGHENTATION, W70-03931 02A

HYPSOMETRIC AWALTSIS
DETERMINING AWD MAPPING THE AVERAGE HYDROLOGIC RESPONSE OF
RASTERN UNITED STATES,
W70-04008
07C

HYSTERESIS
FIELD HEASUREMENT AND USE OF SOIL-WATER PROPERTIES,
W70-03675 02G

ICE BREAKUP
FRACTURE OF LAKE AND SEA ICE,
W70-03651

ILLINOTS
SELECTED ANALYTICAL METHODS FOR WELL AND AQUIPER EVALUATION, W70-03943

O48

IMPACT TEMPERATURE EVAPORATIVE COOLING OF HEATED IRRIGATION WATER BY SPRINKLER APPLICATION, W70-03718 05D

IMPROVEMENTS
POWERS UNDER CITY MANAGER CHARTER.
W70-03749

INDEPENDENCE

ON INDEPENDENCE POSTULATES CONCERNING CHOICE, W70-03832 INDIA
VAPOR LOSSES THROUGH SOIL MULCH AT DIFFERENT WIND
VPLOCITIES,
026 TNDTCATORS IDICATORY
THE HYXOBACTERIA TYPE QUOTIENT AS AN INDICATOR OF EUROPHICATION FOR SURFACE WATERS (IN GERMAN), 970-03963 INDUSTRIAL LINKAGES
THE IMPACT OF INDUSTRIAL LINKAGES ON GEOGRAPHIC ASSOCIATION, W70-03835...068 INDUSTRIAL PRODUCTION
PRODUCTION, CONSUMPTION, AND EXTERNALITIES,
970-03843
068 INDUSTRIAL WASTES

MANAGEMENT OF INDUSTRIAL EFFLUENT DISPOSAL IN BRITAIN,

#70-03877 05D RIODEGRADABILITY AND TREATABLLITY OF COMBINED NYLON AND MUNICIPAL WASTES, \$W70-03926\$TNPILTRATION INDUCED SOIL INSTABILITIES, w70-03648 02G PUNOFF INDUCFMENT IN ARID LANDS, W70-03809 038 COMPARISON OF COMPUTED AND MEASURED MOISTURE REDISTRIBUTION FOLLOWING INFILTRATION, W70-03853 INPILTRATION RATES AS AFFECTED BY DESERT VEGETATION, THP EFFECT CP SOIL MOTSTURE ON INPILTRATION AS RELATED TO RUNOFF AND RPCHARGE, W70-03884 . 02G INFRARED RADIATION
THE THERA-ED DETERMINATION OF QUARTZ IN SEDIMENTS AND
SEDIMENTARY ROCKS,
W70-03678
078 THE INFRA-RED DETERMINATION OF QUARTZ IN SEDIMENTS AND SPOTMENTARY ROCKS, W70-03678 07B INLET DESIGN
SECTION III, FLOW IN GUTTERS SECTION IV, STORM DRAIN
INLETS.
W70-03R16
08A IMLETS
SECTION III, FLOW IN GUTTERS SECTION IV, STORM DRAIN INORGANIC COMPOUNDS
PHYTOPLANKTON NUTRIENT ENRICHMENT EXPERIMENTS OFF BAJA
CALIFORNIA AND IN THE EASTERN EQUATORIAL PACIFIC OCEAN,
05C INPUT-OUTPUT ARALYSIS
RETURNS TO SCALE AND COST CURVES,
W70-03844 INSTITUTIONAL CONSTRAINTS
INSTITUTIONAL PACTORS APPROTING LAND AND WATER DEVELOPMENT,
LOWER RIO GRANDE VALLEY, TEXAS,
W70-03865
068 INSTRUMENTATION USER TRIALS OF A SUBMERSIBLE WATER QUALITY RECORDING METER, W70-03662 05a A BATTERY POWPRED PROPORTIONAL STREAM WATER SAMPLER, W70-03856 INTAKES
SECTION III, PLOW IN GUTTERS SECTION IV, STORM DRAIN INLETS.
W70-03816
08a INTERSTATE COMMISSIONS
TENNESSEE-MISSOURI BRIDGE COUNTSSION.
W70-03752 MISSOURI--ILLINOIS BRIDGE COMMISSION. MISSOURT-ILLINOIS-JEFFERSON-MONROB BRIDGE COMMISSION. W70-03754

INTERSTATE COMPACTS
TENNESSEE-MISSOURI BRIDGE COMMISSION.
W70-03752
06E MISSOURI-ILLINOIS-JEPPERSON-MONROE BRIDGE COMMISSION. INVERTEGRATES
STUDIES ON THE RESISTANCE OF MARINE BOTTOM INVERTEERATES TO OXYGEN-DEFICIENCY AND HYDROGEN SULFIDE,

05c INVESTIGATIONS
COLOR PHOTOGRAPHS FOR WATER RESOURCES STUDIES,
W70-03680 07B APPLICATIONS OF COLOR ABRIAL PHOTOGRAPHY TO WATER RESOURCES STUDIES, W70-03869 INVESTMENT A COMPARATIVE ANALYSIS OF THE NET PRESENT VALUE AND THE BRNPFIT-COST RATIO AS MEASURES OF THE ECONOMIC DESIRABILITY MAXIMUM PROSPECTIVE VALUE CRITFRION, W70-03828 IMPROVED ANIONIC MEMBRANES FOR ELECTRODIALYSIS, \$70-03666 TON-EXCHANGE
DESIGN AND COST OF ION-EXCHANGE SOFTENING FOR A 50-MGD SEAWATER EVAPORATION PLANT,
03A AVAILABILITY OF GROUNDWATER IN WAYNE COUNTY, IOWA, W70-03879 IRON IN NATURAL WATERS--ITS CHARACTERISTICS AND BIOLOGICAL AVAILABILITY AS DETERMINED WITH THE PERRIGRAM, ¥70-03954 WATER FOR WESTERN PEDERAL IRRIGATION PROJECTS, W70-03996 THE ECONOMICS OF AGRICULTURAL WATER USE, W70-03998 06B IRRIGATION EPPICIENCY
FUNCTIONS FOR COTTON (GOSSYPIUM HIRSUTUM L.) PRODUCTION FROM
IRRIGATION AND NITROGEN FERTILIZATION VARIABLES II. YIELD
COMPONENTS AND QUALITY CHARACTERISTICS,
021 FUNCTIONS FOR COTTON (GOSSYPIUM HIRSUTUM L.) PRODUCTION FROM IRRIGATION AND NITROGEN PERTILIZATION VARIABLES I. YIELD AND EVAPOTRANSPIRATION, W70-03806 DISTRIBUTION OF CHLORIDES IN AN IRRIGATED CITRUS ORCHARD, 970-03799 ROOTZONE SALT PROPILES AND ALFALFA GROWTH AS INFLUENCED BY IRRIGATION WATER SALINITY AND LEACHING FRACTION, W70-03807 ISLANDS AND ABANDONED RIVER BEDS. #70-03759 06E ISOTECHNOLOGY CURVES
ON SUBSIDIES TO SPEED THE RATE AT WHICH TECHNOLOGIES ARE
DEVELOPED,

OGB ISRAEL DISTRIBUTION OF CHLORIDES IN AN IRRIGATED CITRUS ORCHARD, LABORATORY TESTS OF SPRAYABLE MATERIALS FOR RUNOFF INDUCEMENT ON A LOESSIAL SOIL, #70-03804 02E RUNOFF INDUCEMENT IN ARID LANDS, W70-03809 038 BEHAVIOR OF BUOYANT JET IN CALM FLUID, 970-03724 088 JET INDUCED CIRCULATION AND DIFFUSION, JOINT COSTS
THE WATER SUPPLY SYSTEM UP TO A.D. 2001,
W70-03842 06C JOINT PRODUCTION
THE WATER SUPPLY SYSTEM UP TO A.D. 2001,
W70-03842 06C JUDICIAL DECISIONS
CONSOLIDATION OF DRAINAGE DISTRICTS.

GRAYSON V COMMINS OF BOSSIER LEVER DISTRICT (COMPENSATION FOR LANDOWNERS FOR LEVER DISTRICT DAMAGES).

PLOOD PLAIN INFORMATION, ARKANSAS RYVER, DODGE CITY, KANSAS. W70-03668

LABORATORY TESTS
COMPARISON OF PILE LOAD-TEST-SKIN-PRICTION VALUES AND
LABORATORY STPENGTH TESTS,
W70-03781
...
08D

COMPARISON STUDIES OF WINKLER VS. OXYGEN SENSOR, W70-03876

TEMPERATURE RELATIONSHIP IN AFROBIC TREATMENT AND DISPOSAL OF POLP AND PAPER WASTES, 05D

LAKE CHAMPLIN(NY)
ECOLOGY OF YEASTS PROM LAKE CHAMPLAIN,
W70-03962
05A

LAKE ICE FRACTURE OF LAKE AND SEA ICF, W70-03651

LAKE ONTARIO STOCHASTIC ASPECTS OF LAKE ONTARIO EVAPORATION, W70-03872 02D

LAKES
"SALT-BISCUITS" - A SPECIAL GROWTH STRUCTURE OF NACL IN SALT
SEDIMENTS OF THE TUZ GOLH ("SALT LAKE"), TURKEY,
W70-03671

APPLICATION OF DESTRICT ANALYSES TO THE HYDROLOGY OF THE TAKES OF THE GRAND COULEE, WASHINGTON, 970-03696

EVAPORATION FROM LARGE DEEP LAKES, W70-03717

COUNTY FISHING LAKES AND RECREATION GROUNDS. W70-03745

BACTERTAL POPULATION OF HUNTFIED LAKES (IN RUSSIAN), W70-03948

CONCEPTS OF EUTROPHICATION AND TROPHIC BIOLOGY, W70-03959 02H

RX POP AILING LAKES--A LOW PHOSPHATE DIET, W70-03964 02H

NTTROGEN METABOLISH IN LAKPS. I. HEASUREMENT OF NITROGEN FIXATION WITH M-15, W70-03970 02H

THE CLASSIFICATION OF LAKES, W70-03984

PLORIDA'S LAKES (PROBLEMS IN A WATER PARADISE), W70-04013

FLORIDA'S LAKES (TESTS OF WAVIGABILITY), W70-04015

PLORIDA'S LAKPS (RTGHTS IN LAKES), W70-04016

LAND DRYELOPHPHT
LEASES OF PFDERAL RESERVOIR LANDS FOR RESORT PURPOSES.
W70-04027
06F

LAND HANAGEMENT

EPPECTS OF PLOOD PROTECTION ON LAND USE IN THE COON CREEK,

WISCONSIN, WATERSHED,

W70-03654

04A

TAND PECLANATION
SWAMP AND OVERPLOWED LAND.
W70-03766

SWAMP AND OWFRPLOWED LANDS (RPCLAMATION AND ASSESSMENT OF DAMAGES). 04A

DRAINAGE DISTRICTS FOR MINING PURPOSES. #70-03761

LAND TRYURE
DUTIES OF DIRECTOR OF PUBLIC WORKS PEGARDING SWAMP LANDS.
W70-03740
06E

LIABILITY OF LANDOWNER TO PERSONS USING LAND. W70-03779

LAND USE

PEPECTS OF PLOOD PROTECTION ON LAND USE IN THE COON CREEK,

#ISCOUSTN, WATPRSHED,

W70-03654

ONA

LIABILITY OF LANDOWNER TO PERSONS USING LAND.

¥70-03779

LARGEMOUTH BASS GROWTH OP LARGEMOUTH BASS FRY AND VARIOUS TEMPERATURES, \$70-03733

LATERAL INFLOWS
THE DETERMINATION OF LOCAL INFLOWS ENTERING & CHARMEL,
02E

LEACHING
PRE-EQUILIBRIUM OBSERVATIONS OF THE RECONSTRUCTED FLAGSTAFF
GULLY DAH,
08D

REGIONAL VARIATIONS OF RIVER WATER COMPOSITION RESULTING FROM HALITE SOLUTION, MACKENZIE RIVER DRAINAGE BASIN,

LPASES
DELTA AND PINE LAND CO OF HISSISSIPPI V BOARD OF SUPERVISORS OF BOLIVAR COUNTY (LEASING OF LEVER DISTRICTS LAND).
W70-03907
04A

LEASES OF FEDERAL RESERVOIR LANDS FOR RESORT PURPOSES. #70-04027

LEGAL ASPECTS
SHAPING THE LAW OF WEATHER CONTROL,
W70-03719

FISH AND GAME (ENFORCEMENT OF GAME AND FISH LAWS). 970-03778

PLORIDA'S LAKES (PROBLEMS IN A WATER PARADISE), W70-04013

LEGISLATION
NATIONAL RIVERS AND HARBORS CONGRESS SUPPORTS A
COMPREHENSIVE WATER RESOURCES DEVELOPMENT PROGRAM,
W70-04043

LEONTIEF MATRICES
AN EXAMINATION OF LINEAR HOMOGENEITY OF TRADE AND PRODUCTION FUNCTIONS IN COUNTY LEONTIEF MATRICES, W70-03824 06A

LEONTIEF HODELS
AN EXAMINATION OF LINEAR HOMOGENEITY OF TRADE AND PRODUCTION FUNCTIONS IN COUNTY LEONTIEF HATRICES, W70-03824

LEONTIFF'S ASSUMPTIONS
AN EXAMINATION OF LINEAR HOMOGENEITY OF TRADE AND PRODUCTION PUNCTIONS IN COUNTY LEONTIEF MATRICES, W70-03824

LEVEE DISTRICTS
GRAYSON V COMP'RS OF BOSSIER LEVEE DISTRICT (COMPENSATION FOR LANDOWNERS FOR LEVEE DISTRICT DAMAGES).
W70-03903
06E

DELTA AND PINE LAND CO OF MISSISSIPPI V BOARD OF SUPERVISORS OF BOLIVAR COUNTY (LEASING OF LEVEE DISTRICTS LAND). W70-03907

LEVEES
DELTA AND PINE LAND CO OF MISSISSIPPI V BOARD OF SUPERVISORS
OF BOLIVAR COUNTY (LEASING OF LEVEE DISTRICTS LAND).
W70-03907
04A

LEVEE DISTRICTS. W70-04021

CITIES OF THIRD CLASS (POWER TO REGULATE LEVEES). W70-04038

LICENSPS
PERRIES AND WHARVES.
W70-03755

NAVIGATION (ERECTION OF AIDS TO NAVIGATION). W70-03916 06E

LIGHT
A METHOD POR PREDICTING THE EFFECTS OF LIGHT INTENSITY ON ALGAL GROWTH AND PHOSPHOROUS ASSIMILATION, W70-03923
OSC

LIGHT WATER
LIGHT WATER AND PROTEIN FOAM.
W70-03813

LINEAR ALKYL SULFONATES
ANIONIC AND MONIONIC SURFACTANT SORPTION AND DEGRADATION BY
ALGAY CULTURES,
W70-03928
O5D

LIMEAR HOMOGENEITY AS EXAMINATION OF LIMEAR HOMOGENEITY OF TRADE AND PRODUCTION FUNCTIONS IN COUNTY LEGISTIES HATRICES, W70-03824

LINPAR PROGRAMMING RESERVOIR SYSTEM DESIGN OPTIMIZATION, W70-03941 04A

AN ACTIVITY ANALYSIS OF NON-STRUCTURAL PLAIR MARAGEMENT ALTERNATIVES CHAPTER IV, 870-04003 06F

LINEAR THEORY LINEAR THEORY, W70-03993 O6A
LOAD DISTRIBUTION DISTRIBUTION OF CONCENTRATED LOADS ON ORTHOTRODIC RRIDGE
DECKS, W70-03798 08%
LOCAL GOVERNMENTS DRAINAGE AND LEVEE DISTRICTS. W70-03741 04A
BRIDGES. W70-03751 068
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
CITY OF PORT RICHEY V ADAMEK (CONSTRUCTION OF A DOCK EITENDING INTO A NAVIGABLE RIVER). W70-03763
PORDS AND PUBLIC BRIDGES (CLEARING OF PORDS AND BUILDING OF
BRIDGES). W70-03773 068
CITIES OF THIRD CLASS (POWER TO REGULATE LEVEES). W70-04038
LOCAL SUBSIDIES THE OPTIMALITY OF LOCAL SUBSIDIES TH REGIONAL DEVELOPMENT
PROGRAMS, W70-03838 . 06B
LOCATIONAL EQUILIBRIA
LOCATIONAL EQUILIBRIA, W70-03839 06A
LOUISIANA THE TIDELANDS CONTROVERSY AND LOUISIANA'S EXPERIENCE IN THE
DISPUTE, W70-03688 - 06E
GRAYSON V COMMIRS OF BOSSIER LEVEE DISTRICT (COMPENSATION
FOR LANDOWNERS FOR LEVEE DISTRICT DAMAGES). W70-03903
MAKE OR BUY DECISION COPING WITH UNCERTAINTY IN THE MAKE OR BUY DECISION, W70-03826 068
MANAGEMENT
AN ACTIVITY ANALYSIS OF NON-STRUCTURAL PLAIN MANAGEMENT ALTPRNATIVES CHAPTER IV, W70-04003
DRATHAGP DISTRICTS ORGANIZED IN COUNTY COURT.
W70-04020 04A 54A 54A 54A 54A 54A 54A 54A 54A 54A 5
RADIOCARBON AGES OF GROUNDWATER IN AN ARID ZONE UNCONFINED ADUTER, W70-03895
MARINE ENVIRONMENT
SUPPACE SLICES AS CONCENTRATORS OF PESTICIDES IN THE HARING PRVIRONMENT, W70-03953
MARTNE MICROORGANISMS
DISTRIBUTION, CHARACTERIZATION, AND NUTRITION OF MARINE MICROORGANISMS FROM THE ALGAE POLYSIPHONIA LANGSA AND ASCOPHYLLUM NODOSUM,
W70-03952 05C
THE RESPONSE OF NATURAL MICROBIAL POPULATIONS IN SEAWATER TO ORGANIC ENRICHMENT,
w70-03967 05c
BACTERIAL GROWTH RATE IN THE SEA DIRECT ANALYSIS BY THYMIDINE AUTORADIOGRAPHY, W70-03968 05C
HARINE STUDIES
HARINE RADIOECOLOGY, W70-03956 05C
MARKOV PROCESSES A PROPERTY OF THE RANGE OF PARTIAL SUMS, W70-03701 07A
AN ANALYSIS OF RUNS OF PRECIPITATION EVENTS, W70-03702 07C
MASS CURVES
GRIERALIZED DROUGHT SEQUENCE PROBABILITIES FOR STORAGE-DRAFT PREGNENCY ANALYSIS, W70-03904 02E
MASS TRANSPORT
ON THE ROLES OF VERTICAL VELOCITY AND EDDY CONDUCTIVITY IN MAISTAINING A THERNOCLINE, \$70-03730 02L
MATHEMATICAL MODEL
THERMAL CIRCULATION ON A ROTATING SPHERE WITH APPLICATION TO THE OCRANIC THERMOCLINE, 870-03725
ON THE ROLES OF VERTICAL VELOCITY AND EDDY CONDUCTIVITY IN
PARTITION & BURDHOCITYP .

```
USES OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL
   STUDIES CHAPTER IV, W70-03934
                                                           058
NATHEMATICAL HODELS
DEVELOPMENT OF MATHEMATICAL HODEL AND COMPUTER PROGRAM FOR
OPTIMIZATION OF VERTICAL TUBE EVAPORATOR SALINE WATER
   POTENTIAL EVAPORATION AS A MANIFESTATION OF REGIONAL EVAPORATION, W10-03676 02D
   A NUMERICAL MODEL FOR THE HYDROLOGIC TRANSPORT OF
RADIOACTIVE ARROSOLS FROM PRECIPITATION TO WATER SUPPLIES,
W70-03698
   THE DETERMINATION OF LOCAL INFLOWS ENTERING A CHANNEL, W70-03699
   A HODEL FOR GENERATING SYNTHETIC SEQUENCES OF SHORT-TIME-INTERVAL RAINFALL DEPTHS, 02B
   A MOSAIC TECHNIQUE FOR GENERATING THE DAILY PATTERN WITHIN A SYNTHETIC FLOW SEQUENCE, W70+03704
   NUMBRICAL SIMULATION OF WITHDRAWAL FROM A STRATIFIED
   ANISOTROPIC PERMEABILITY OF PRACTURED MEDIA, W70-03870
   AN ERROR PUNCTION DESCRIPTION OF THE VERTICAL SUSPENDED SEDIMENT DISTRIBUTION, 02J
   SIMILITUDE FOR PARTIALLY SATURATED FLOW SYSTEMS, #70-03883
   USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES CHAPTER III, W70-03933 05B
   EXAMINATION INTO THE EFFECTIVENESS OF THE CONSTRUCTION GRANT PROGRAM FOR ABATING, CONTROLLING AND PREVENTING WATER POLLUTION.
W70-03936
OSG
   COST, PRECISION, AND VALUE RELATIONSHIPS OF DATA COLLECTION AND DESIGN ACTIVITIES IN WATER DEVELOPMENT PLANNING, W70-03938
   SELECTED ANALYTICAL METHODS FOR WELL AND AQUIFER EVALUATION, W70-03943
   TRICKLING FILTER MODEL DESIGN AND COST FACTORS,
MATHEMATICAL STUDIES REDUCTION OF ARNUAL RIVER FLOWS TO LONGER PERIODS (RUSSIAM), W70-03681 02E
  CALCULATION OF MAXIMUM DISCHARGES OF CRIMEAN RIVERS (RUSSIAN), W70-03682 02E
   CONSTRAINED RANDON WALK HEANDER GENERATION, W70-03866
MEANDERS
HEASUREMENT
PORE PRESSURE HEASUREMENTS IN THE FIELD AND IN THE
LABORATORY, PART I AND PART II,
W70-03797
08D
  SEDIMENT-WATER NUTRIENT INTERCHANGE, #70-03980
HECHANICAL CHEMICAL
THE WATER-RESOURCE COMMUNICATIONS GAP,
W70-03841 06D
   SNOW ALBEDO MODIFICATION - A REVIEW OF LITERATURE, W70-03652
   W70-03652
  IMPROVED ANIONIC MEMBRANES FOR ELECTRODIALYSIS, #70-03666 03A
  THERMO-OSMOSIS THROUGH COMPACTED SATURATED CLAY MEMBRANES, 970-03859
  ONONDAGA LAKE, NEW YORK--AN UNUSUAL ALGAL ENVIRONMENT, W70-03974
HETABOLISH
MITROGEN HETABOLISH IN LAKES. I. HEASUREHENT OF NITROGEN
FIXATION WITH N-15,
W70-03970
02H
METEOROLOGY
```

ON THERMALLY MAINTAINED CIRCULATION IN A CLOSED OCEAN BASIN, W70-03732

SUBJECT INDEX MET-MOI

mmy-moi			
THE APPLICATION OF ISOTOPES TO SOME P SCIENCES, W70-03690	ROBLEMS IN ATMOSPHERIC	THERMAL DISCHARGE AND WATER QUALITY I RESERVOIR, W70-03845	N A 1,500-ACRE
MICHIGAN FLOOD PLAIN INFORMATION, LOOKINGGLASS MICHIGAN.		COSTS AND MAINTENANCE OF DRAINAGE DIS W70-03912	STRICTS. 04A
W70-03868 STRATÉGY POP MICHIGAN WATER RESOURCES	04A MANAGEMENT A SYSTEMS	DRAINAGE DISTRICTS ORGANIZED IN COUNT W70-04020	Y COURT. 04A
APPROACH, W70-03944	06B	LEVEE DISTRICTS.	04a
MICROPACTFRIAL ACTION FERMENTATION OF SPENT SULPITE LIQUOR VOLATILE ACIDS,	FOR THE PRODUCTION OF	WATER SUPPLY DISTRICTS. W70-04022	06 B
W70-03921		SPWER DISTRICTS (CONSTRUCTION OF SEWE JURISDICTIONS).	RS IN UNINCORPORATED
MICRORIAL POPULATIONS THE RESPONSE OF NATURAL MICROBIAL POP ORGANIC ENPICHMENT,	ULATIONS IN SEAWATER TO	W70-04023	06E
W70-03967	05C	CLASS TWO COUNTIES - SEWER DISTRICTS. W70-04024	06E
W70-03967 MINERAL WATER		SEWERAGE - WATER WORKS. W70-04025	05G
THIRD CLASS CITIES. W70-04037	0 4 A	FISH AND GAME (THE WILDLIFE AND FORES W70-04026	TRY LAW). 06E
MINERALOGY HTNPRAL RTGHTS VPRSUS WATER PIGHTS, W70-03735	062	LEASES OF FEDERAL RESERVOIR LANDS FOR W70-04027	RESORT PURPOSES.
MINING DRAINAGE DISTRICTS FOR MINING PURPOSE #70-03761	S. 04A	WATER RESOURCES BOARD. W70-04028	06E
OCEAN MINERALS AND THE LAW,		WATER CONSERVANCY DISTRICTS. W70-04029	030
W70-03822	96E	W70-04030	030
MINNESOTA UNITED STATES V 967.905 ACRES OF LAND COMPENSATION FOR BARGES ON LAKE SURRO	(CONDEMNEES DEMAND	W70-04031	06E
LAND). W70-03765	06E	GENERAL SEWER SYSTEM. W70-04033	05G
MISSISSIPPT DPLTA AND PINE LAND CO OF MISSISSIPPI OF BOLIVAR COUNTY (LEASING OF LEVEE D		PRIVATE SEWERS. W70-04034	05G
W70-03907	04A	PUBLIC UTILITIES.	03D
MISSISSIPPI RIVER BOUNDARIES (STATE). W70-03747	06R	PUBLIC HEALTH (HUNICIPAL WATER SUPPLY W70-04036	
MTSSOURT RRIDGES.		THIRD CLASS CITIES. W70-04037	04A
W70-03750 W70-03751	06E	CITIES OF THIRD CLASS (POWER TO REGUL W70-04038	ATE LEVEES).
TENNESSEE-HTSSOURI BRIDGE COMMISSION.	062	BOUNDARIES BY WATERCOURSES.	06E
MISSOURITLLINGIS BRIDGE COMMISSION.		PRIVATE SEWERS.	
W70-03753 MISSOURT-ILLINOIS-JEPPERSON-MONROE BR	OGR IDGE COMMISSION.	W70-04040 HISSOURI SOIL AND WATER CONSERVATION	OSG DISTRICTS LAW.
W70-03754 FERRIES AND WHARVES.	068	W70-04041 TAXATION OF BRIDGE AND PUBLIC UTILITY	O3D COMPANIES
W70-03755 SWAMP AND OVERPLOWED LAND.	068	¥70-04042	06 E
¥70-03756	· 04A	MIXING BEHAVIOR OF BUOYANT JET IN CALM PLUID W70-03724	088
SWAMP AND OVERFLOWED LANDS (PATENTS A W70-03757		MOBILE-BED HYDRAULICS	
SWAMP AND OVERFLOWED LANDS (RECLAMATI DAMAGES).	ON AND ASSESSMENT OF	HOBILE-BBD FLUVIOLOGY, R70-03669	025
W70-03758	048	MODEL STUDIES	
ISLANDS AND ABANDONED RIVER BEDS. W70-03759	068	THERMAL CIRCULATION ON A ROTATING SPH TO THE OCEANIC THERMOCLINE, W70-03725	O2L
ANNEXATION OF OLD DRAINAGE DISTRICTS DISTRICTS.		NUMERICAL METHOD FOR ESTIMATING SIMULAND SALT IN UNSATURATED SOILS,	
W70-03760 DRAINAGE DISTRICTS FOR MINING PURPOSE	04A 5.	W70-03851 HYDROLOGIC EFFECTS OF RAINFALL AUGUEN	02G
W70-03761 CONSOLIDATION OF DRAINAGE DISTRICTS.	048	W70-03931	024
W70-03762 SEMER DISTRICTS ST. LOUIS COUNTY. W70-03767	05G	STRATEGY FOR MICHIGAN WATER RESOURCES APPROACH, W70-03944	NANAGEMENT A SYSTEM 06B
SANITARY DRAINAGE DISTRICTS-CITIES OF AND ADJOINING COUNTIES.		MOISTURE AVAILABILITY YIRLD-PROTEIN RELATIONSHIPS IN WHEAT NITROGEN AND WATER,	GRAIN, AS AFFECTED BY
LIGHTDATOR FOR SEWEP DISTRICTS IN CER	TATH COUNTIES.	N70-03800	02G
WATER DEVELOPMENT FUND.	056	PIELD HEASUREMENT AND USE OF SOIL-WAT W70-03675	ER PROPERTIES, 02G
H70-03770	06C	COMPARTSON OF COMPUTED AND MEASURED &	OISTORE REDISTRIBUTION
MISSOURI FEDERAL WATER PROJECTS RECRE	ATION PUND. 06C	FOLLOWING INFILTRATION, W70-03853	02G

MONITORING USER TRIALS OF A SUBMERSTBLE WATER QUALITY RECORDING METER, \$70-03662 05a	NEW ZEALAND ALPINE WATERSHED, W70-03908 02E
DEVELOPMENT OF A RADIOISOTOPE GAGE FOR MONITORING SEDIMENT CONCENTRATION. IN RIVERS AND STREAMS, W70-03687	NITRATES STATISTICAL EVALUATION OF SALINITY AND NITRATE CONTENT AND TRENDS BENEATH URBAN AND AGRICULTURAL AREA-FRESHO, CALIFORNIA,
HUD (LAKE) AVAILABILITY OF HUD PHOSPHATES FOR THE GROWTH OF ALGAE, W70-03955	W70-03649 NITRATE CONTENT OF THE HPPER RIO GRANDE AS INPLUENCED BY NITROGEN PERTILIZATION OF ADJACENT IRRIGATED LANDS,
MULCHING VAPOR LOSSES THROUGH SOIL MULCH AT DIPPERENT WIND VELOCITIES,	W70-03849 05B
W70~03808 02G	YIELD-PROTEIN RELATIONSHIPS IN WHEAT GRAIN, AS AFFECTED BY MITROGEN AND WATER, W70-03800 026
BIODEGRADABILITY AND TREATABILITY OF COMBINED NYLON AND MUNICIPAL WASTES, 05D	PUNCTIONS FOR COTTON (GOSSIPIUM HIRSUTUM L.) PRODUCTION FROM IRRIGATION AND NITROGEN FERTILIZATION VARIABLES II. YIELD COMPONENTS AND QUALITY CHARACTERISTICS, W70-03805
GENERAL SEWER SYSTEM. W70-04033 05G	NITROGEN PIXATION NITROGEN METABOLISM IN LAKES. I. MEASUREMENT OF NITROGEN
PRIVATE SERERS. W70-04034 05G	FIXATION WITH K-15, W70-03970 02H
MUNICIPAL WATER PUBLIC UTILITIES, W70-04035 03D	NITROGEN-15 NITROGEN HETABOLISM IN LAKES. I. HEASUREMENT OF NITROGEN FIXATION WITH N-15, W70-03970 02H
MYXOBACTERIA THE MYXOBACTERIA TYPE QUOTIENT AS AN INDICATOR OF EUTROPHICATION FOR SURFACE WATERS (IN GERMAN), W70-03963 02H	NON-CONSUMPTIVE USE PLORIDA'S LAKES (RIGHTS ATTRIBUTABLE TO NAVIGABLE LAKES), W70-04017 06E
NAJAS PLEXILIS FXCRETION OF DISSOLVED ORGANIC COMPOUNDS BY AQUATIC MACROPHYTES,	FLORIDA'S LAKES (RIGHTS OF THE PUBLIC), W70-04018 06E
W70-03951 05C NATIONAL REACTOR TESTING STATION	FLORIDA'S LAKES (RIGHTS OF COMMERCIAL USERS), W70-04019 06E
USE OF CHEMICAL AND RANTOACTIVE TRACERS AT THE NATIONAL REACTOR TESTING STATION, IDAHO, W70-03893 02F	NON-NAVIGABLE WATERS FLORIDA'S LAKES (RIGHTS OF COMMERCIAL USERS), W70-04019 06E
NAVIGABLE RIVERS CITY OF PORT RICHEY V ADAMEK (CONSTRUCTION OF A DOCK EXTENDING INTO A NAVIGABLE RIVER). 044	NORTH CAROLINA THE FUTURE OF THE NORTH CAROLINA COASTAL AREA. W70-04032 05g
KOMMANVITTSELSKAPET HARWI V UNITED STATES (ACTION AGAINST PEDERAL GOVERNMENT FOR ALLEGED FAILURE TO HAINTAIN CHANNEL) W70-03766	NUCLEAR DENSITY METERS HINIMIZING NUCLEAR SOIL DENSITY AND MOISTURE CONTENT GAGE ERRORS, W70-03787 07B
NAVIGABLE WATERS FLORIDA'S LAKES (TESTS OF NAVIGABILITY), W70-04015 06E	NUCLEAR METEOROLOGY THE APPLICATION OF ISOTOPES TO SOME PROBLEMS IN ATMOSPHERIC SCIENCES, W70-03690 02B
PLORTDA'S LAKES (RIGHTS OF THE PUBLIC), W70-04018 06E	NUCLEAR HOISTURE METERS DESIGN OF A NEUTRON SCATTERING WATER CONTENT GAGE FOR SOILS,
NAVIGATION KOMMANVITTSPLSKAPET HARWI V UNITED STATES (ACTION AGAINST PRDERAL GOVERNMENT FOR ALLEGED FAILURE TO HAINTAIN CHANNEL) W70-03766 044	#70-03686 07B HINIMIZING NUCLEAR SOIL DENSITY AND MOISTURE CONTENT GAGE ERRORS, 770-03787 07B
NAVIGATION (ERECTION OF AIDS TO NAVIGATION). W70-03916	DETERMINING SPECIFIC YIELD OF THE OGALLALA AQUIFER BY THE MEUTRON METHOD,
NAVIGATIONAL AIDS NAVIGATION (ERPCTION OF AIDS TO NAVIGATION). W70-03916 06F	W70-03871 02F NUCLEAR REACTORS BIOLOGICAL EFFECTS OF HANFORD HEAT ON COLUMBIA RIVER FISHES
NEGATIVE PORE PRESSURE APPLICATION OF PORE PRESSURE MEASUREMENTS TO SHEAR STRENGTH OF CORESIVE SOILS,	A REVIEW, W70-03721 . 05C
W70-03788 07B	NUTRIENT BEQUIREMENTS DISTRIBUTION, CHARACTERIZATION, AND NUTRITION OF MARINE MICROORGANISMS FROM THE ALGAE POLYSIPHONIA LANGSA AND
DIPLOGASTERID AND RHABDITID NEWATODES IN A WASTEWATER TREATMENT PLANT, W70-03925	ASCOPHYLLUM NODOSUM, W70-03952 05C
NETTED PRESENT VALUE A COMPARATIVE AWALYSIS OF THE NET PRESENT VALUE AND THE BENEFIT-COST RATIO AS HEASURES OF THE ECONOMIC DESIRABILITY	NYLON BIODEGRADABILITY AND TREATABILITY OF COMBINED NYLON AND MUNICIPAL WASTES, W70-03926 O5D
OF INVESTMENTS, W70-03825 BEUTRON ARSOPPTION DESIGN OF A NEUTRON SCATTERING WATER CONTENT GAGE FOR SOILS	NYLON WASTE BIODEGRADABILITY AND TREATABILITY OF COMBINED NYLON AND HUNICIPAL WASTES, W70-03926 05D
W70-03686 07B NEUTRON SCATTERING DESIGN OF A NEUTRON SCATTERING WATER CONTENT GAGE FOR SOILS	OCEANS OCEAN MINEBALS AND THE LAW,
W70-03686 07B NEW JERSRY GEOLOGY AND GROUNDWATER RESOURCES OF OCEAN COUNTY, NEW	ODOR PRIVATE SEWERS. W70-04040 05G
GEOLOGY AND GROUNDWATER RESOURCES OF OCEAN COUNTY, NEW JERSEY, 870-03670	OHIO PRIVATE SEWER SYSTEMS.
NEW YORK BIBLIOGRAPHY OF THE GROUNDWATER RESOURCES OF NEW YORK	W70-03736 05G
THROUGH 1967, W70-03659 02F	970-03737 05G
NEW ZEALAND A DEFINCTION COMPONENT ANALYSIS OF SURFACE RUNOFF DATA FROM	WATERCOURSES (ALTERATION FOR BRIDGE CONSTRUCTION). A W70-03738 044

REGULATION OF PERRY OPERATIONS. 06E DUTIES OF DIRECTOR OF PUBLIC WORKS REGARDING SWAMP LANDS. LEGAL ACTIONS RELATING TO WATERCRAFT. W70-03915 06E HAVIGATION (PRECTION OF AIDS TO WAVIGATION) . WATERSHED DISTRICTS. #70-03917 OHTO RIVER NAVIGATION (ERECTION OF AIDS TO NAVIGATION). W70-03916 06E OIL SPILLS
RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OTL
DISPERSING PRODUCTS, OMONDAGA LAKP(NY) ONONDAGA LAKP, NEW YORK--AN UNUSUAL ALGAL ENVIRONNENT, 870-03074 OSC OPEN CHANNEL PLOW MOBILE-BED PLUVIOLOGY, W70-03669 THE DETERMINATION OF LOCAL INFLOWS ENTERING A CHANNEL, \$170-03699 SECTION V, FLOW IN STORM DRAINS AND THEIR APPURTENANCES SECTION VI, DESIGN OF CLOSED STORM DRAINAGE SYSTEM SECTION VII, DESIGN OF OPEN CHANNELS. 870-03817 OPERATIONS
TUBE CLARIFICATION PROCESS, OPERATING EXPERIENCES, W70-03911 OPERATIONS RESEARCH OPERATIONS RESEARCH, N70-03992 06 A OPPORTUNITY COSTS

MAXIMUM PROSPPCTIVE VALUE CRITERION,
W70-03828 THE WATER SUPPLY SYSTEM UP TO A.D. 2001 OPTIHIZATION
THE DYNAMIC PROGRAMMING APPROACH TO WATER-RESOURCES
DEVELOPMENT,
068 THE OPTIMALITY OF LOCAL SUBSIDIES IN REGIONAL DEVELOPMENT PROGRAMS, 96B USP OF HATHPMATICAL HODRLS IN WATER QUALITY CONTROL STUDIES CHAPTER III, W70-03933 05B COST, PRECISION, AND VALUE RELATIONSHIPS OF DATA COLLECTION AND DRSIGN ACTIVITIES IN WATER DEVELOPMENT PLANNING, #70-03938 SIBULATION MODEL FOR PLOW AUGMENTATION COSTS, W70-03940PESERVOIR SYSTEM DESIGN OPTIMIZATION, 04A TECHNOLOGY OF SEA WATER DESALINATION, W70-03946 03A THE ECONOMICS OF AGRICULTURAL WATER USE, W70-03998 ... 068 OREGON LAKES
THP CLASSIFTCATION OF LAKES, W70-03984 02R ORGANIC MATTER
SOIL BREFFRATORY ACTIVITY AND ORGANIC MATTER DEPLETION IN AN ARID MEYADA SOIL,
W70-03801 026 THE RESPONSE OF NATURAL MICROBIAL POPULATIONS IN SEAWATER TO ORGANIC ENFICHMENT, W70-03967 05C ORGANISMS
EVIDENCE FOR EUTPOPHICATION FROM REMAINS OF ORGANISMS IN
SEDIMENTS,
W70-03977
02H ORTHOTROPIC BRIDGES
FIELD TESTS OF ALUBTHUM ORTHOTROPIC BRIDGE DECK,
W70-03795 08G

THERMO-OSMOSIS THROUGH COMPACTED SATURATED CLAY HEEDRAMES, W70-03859 02G OUTLET
BEHAVIOR OF BUOYANT JET IN CALM FLUID,
W70-03724
088 OUTLET WORKS SECTION VIII, DESIGN OF CULVERTS. W70-03818 OUTLETS
ANNEXATION OF OLD DRAINAGE DISTRICTS BY NEW DRAINAGE OVERFLOW
SWAMP AND OVERFLOWED LANDS (RECLAMATION AND ASSESSMENT OF OVERLAND FLOW
THE DETERMINATION OF LOCAL INFLOWS ENTERING A CHANNEL,
W70-03699 02E OWNERSHIP OF BEDS ISLANDS AND ABANDONED RIVER BEDS. W70-03759 OXIDATION
TEMPERATURE EFFECTS ON ENERGY OXIGEN REQUIREMENTS IN
BIOLOGICAL OXIDATION,
OSD OXIGEN DEMAND
TEMPERATURE EFFECTS ON ENERGY OXIGEN REQUIREMENTS IN
BIOLOGICAL OXIDATION,
W70-03919
05D OXYGEN REQUIREMENTS
THE BELATION OF TEMPERATURE TO OXYGEN CONSUMPTION IN THE GOLDFISH, STUDIES ON THE RESISTANCE OF MARINE BOTTOM INVERTERATES TO OXIGEN—DEPICIENCY AND HYDROGEN SULFIDE, $100\,\mathrm{Cm}$ PACIFIC HORTHWEST
RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL DISPERSING PRODUCTS,
W70-03913
OSC PATERTS
SWARP AND OVERPLOWED LANDS (PATERTS AND CONTRACTS).
W70-03757
04A PATH OF POLLUTANTS
A NUMERICAL HODEL FOR THE HYDROLOGIC TRANSPORT OF
RADIOACTIVE AEROSOLS FROM PRECIPITATION TO WATER SUPPLIES,
W70-03698
02A PRAK DISCHARGE
A PRAK DISCHARGE RELATION FOR INTERMEDIATE DRAINAGE BASINS,
W70-03855 PURPOSE AND PERFORMANCE OF PEAK PREDICTIONS, W70-03887 PENALTIES (CRIHINAL)
CONSOLIDATION OF DRAINAGE DISTRICTS.
W70-03762 FISH AND GARE (THE WILDLIFE AND PORESTRY LAW). N70-04026 PENNSYLVANIA CORPORATE POWERS (REGULATION OF WATER SUPPLY - PLOOD CORTROL). W70-03685 04a PERCOLATION
INFILTRATION INDUCED SOIL INSTABILITIES,
W70-03648
02G SOIL FACTORS INFLUENCING PERCOLATION TEST PERFORMANCE, W70-03850 PERMEABILITY
ANISOTROPIC PERMEABILITY OF FRACTURED MEDIA,
W70-03870 02F PERMITS
FRRIES AND WHARVES.
W70-03755 068 PESTICIDES
SURFACE SLICES AS CONCENTRATORS OF PESTICIDES IN THE NARIHE ENVIRONMENT,
W70-03953
054 PHOSPHATES
PHOSPHATE REMOVAL AT BALTIMORE, HARYLAND, W70-03930
05D THE ROLE OF PHOSPHATE-SOLUBLE BACTERIA IN THE ASSIBILATION OF ROCK PROSPHATE PROSPHORUS UNDER CONDITIONS OF

ONOBACTERIAL CULTURE (IN RUSSIAN), RX FOR ALLING LAKES--A LOW PHOSPHATE DIET, PHOSPHORUS AVAILABILITY OF MUD PHOSPHATES FOR THE GROWTH OF ALGAE, W70-03955 THE ROLE OF PHOSPHATE-SOLUBLE BACTERIA IN THE ASSIMILATION OF BOCK PROSPHATE PHOSPHORUS UNDER CONDITIONS OF MONOBACTERIAL CULTURE (IN BUSSIAN), 05C PRINCIPLES OF PRIMARY PRODUCTIVITY COMPLETELY NATURAL CONDITIONS, PHOTOSYNTHESIS UNDER PHOTOSYNTHESIS
PRINCIPLES OF PRIMARY PRODUCTIVITY
COMPLETELY NATURAL CONDITIONS, PHOTOSYNTHESIS UNDER 0.28 PHYCOLOGY ALGAE, MAN, AND THE ENVIRONMENT. W70-03973 PHYSICOCHEMICAL TREATMENT
PHYSICOCHEMICAL TREATMENT OF WASTEWATER,
W70~03927 PHYSIOLOGICAL FCOLOGY
SOME POSSIBLE PHYSIOLOGICAL STRESSES INDUCED BY
EUTROPHICATION,
W70-03976 0.5C PHYSTOLOGICAL ECOLOGY, W70-03978 050 PHYSIOLOGICAL STRESSES
SOME POSSIBLE PHYSIOLOGICAL STRESSES INDUCED BY
BUTPOPHICATION, PHYTOPLANKTON
PHYTOPLANKTON NUTPIENT PARTICHMENT EXPERIMENTS OFF BAJA
CALIFORNIA AND IN THE EASTERN EQUATORIAL PACIFIC OCEAN,
W70-03949
05C PILE TESTS
COMPARISON OF PILE LOAD-TEST-SKIN-PRICTION VALUES AND LABORATORY STRENGTH TESTS, W70-03781 08D PTIES (FOUNDATIONS)
COMPARISON OF PILE LOAD-TEST-SKIN-FRICTION VALUES AND
LABORATORY STRENGTH TESTS,
W70-03781
OBD PILOT INVESTIGATION
PHOSPHATE REMOVAL AT BALTTMORE, MARYLAND,
W70-03930 05D SECTION V, FLOW IN STORM DRAINS AND THEIR APPURTENANCES SECTION VT, DESIGN OF CLOSED STORM DRAINAGE SYSTEM SECTION VII, DESIGN OF OPEN CHANNELS. W70-03817 088 PTPELINES
HOLK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL STIPS SUMMARY REPORT,
W70-04004
05E BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES VOLUME TII - TECHNICAL ASPECTS OF PIPELINTING OF WASTE MATERIALS, PIPING (PROSION)
PRE-EQUILIBRIUM OBSERVATIONS ON THE RECONSTRUCTED FLAGSTAFF
GULLY DAM,
W70-03782
08D A MATHEMATICAL MODEL FOR PIT SLOPE STABILITY, W70-03794 08E PLACER MINING
OCEAN MINERALS AND THE LAW,
W70-03822 PLANNING
RELATIVE IMPORTANCE OF VARIABLES IN WATER RESOURCES
PLANNING,
#70-03656
06B EXAMINATION INTO THE EPPECTIVENESS OF THE CONSTRUCTION GRANT PROGRAM FOR ABATING, CONTROLLING AND PREVENTING WATER POLLUTION. PORE PRESSURE MEASUREMENTS IN THE FIELD AND IN THE LABORATORY, PART I AND PART II, ... ORD COST, PRECISION, AND VALUE RELATIONSHIPS OF DATA COLLECTION AND DESIGN ACTIVITIES IN WATER DEVELOPMENT PLANNING, W70-03938 BIOSTIMULATION AND TOXICITY CRITERIA AND APPLICATIONS IN DESIGN-PRESENT PRACTICE AND PUTURE POSSIBILITIES, W70-03982 PORE WATER PRESSURES

APPLICATION OF PORE PRESSURE MEASUREMENTS TO SHEAR STRENGTH

OF CONFSIVE SOILS,

THE WATERSHED AS AN ENTITY FOR PLANNING W70-03987 COMMENT ON, "THE WATERSHED AS AN ENTITY FOR PLANNING", W70-03988 WATER ADMINISTRATION - A SUGGESTED INSTITUTIONAL MODEL, W70-04010 ¥70-04011 06E W70-04012 06 E PLANT GROWTH YIELD-PROTEIN RELATIONSHIPS IN WHEAT GRAIN, AS AFFECTED BY NITROGEN AND WATER, FUNCTIONS FOR COTTON (GOSSYPIUM HIRSUTUM L.) PRODUCTION FROM IRRIGATION AND NITROGEN FERTILIZATION VARIABLES II. VIELD COMPONENTS AND QUALITY CHARACTERISTICS, W70-03805 FUNCTIONS FOR COTTON (GOSSYPIUM HIRSUTUM L.) PRODUCTION PROM IBRIGATION AND NITROGEN PERTILIZATION VARIABLES I. VIELD AND EVAPOTRANSPIRATION, W70-03806 021 ROOTZONF SALT PROPILES AND ALFALFA GROWTH AS IMPLUENCED BY IRDIGATION WATER SALINITY AND LEACHING PRACTION, W70-03807 PLANT INVESTIGATION
PHOSPHATE REMOVAL AT BALTIMORE, MARYLAND
W70-03930
05 BREAKTHROUGH IN THE TRACER STUDIES OF SEDIMENTATION TANKS, 70-03922 PLUMES
HOTION OF TWO DIMENSIONAL STARTING PLUME,
081 POINT DILUTION METHOD
GROUNDWATER FLOW AND DIRECTION MEASUREMENT BY MEANS OF
RADIOISOTOPES IN A SINGLE WELL, POLITICAL ASPECTS
SHAPING THE LAW OF WEATHER CONTROL, W70-03719 06 E BOUNDARIES (STATE). ADMINISTRATIVE ARRANGEMENTS FOR WATER RESOURCES DEVELOPMENT IN HONTAWA, w70-04044 06E POLITICO-ADMINISTRATIVE
ADMINISTRATIVE ARRANGEMENTS FOR WATER RESOURCES DEVELOPMENT
IN MOHTANA,
W70-04044
06E POLLUTION
THE WATER-RESOURCE COMMUNICATIONS GAP,
W70-03841 06D ELUTION ABSTRACES
EXAMINATION INTO THE EFFECTIVENESS OF THE CONSTRUCTION GRANT PROGRAM FOR ABSTRACE, CONTROLLING AND PREVENTING WATER POLLUTION.
W70-03936
OSG POLYSIPHONIA LANGSA
DISTRIBUTION, CHARACTERIZATION, AND NUTRITION OF MARINE
MICROORGANISMS FROM THE ALGAE POLYSIPHONIA LANGSA AND
ASCOPHYLLUM MODOSUM, POPULATION
BACTERIAL POPULATION OF HUMIFIED LAKES (IN BUSSIAN),
W70-03948
02H CARBON SOURCES IN ALGAL POPULATIORS AND ALGAL COMMUNITY STRUCTURE, #70-04001 05B PORE AIR PRESSURES
APPLICATION OF PORE PRESSURE MEASUREMENTS TO SHEAR STREEGTH
OF COHESIVE SOILS, PORE PRESSURE MEASUREMENTS IN THE FIELD AND IN THE LABORATORY, PART I AND PART II, W70-03797 08D PORE PRESSURE
APPLICATION OF PORE PRESSURE MEASUREMENTS TO SHEAR STRENGTH
OF CORESIVE SOILS,

07B

PORE PRESSURE HEASUREMENTS IN THE FIELD AND IN THE LABORATORY, PART I AND PART II, 09D

POROSITY

VAPOR LOSSES THROUGH SOIL MULCH AT DIFFERENT WIND

VELOCITIES,

02G

POROUS MEDIA ANTSOTROPIC PERMEABILITY OF PRACTURED MEDIA, 02P

PORTLAND CEMPNTS
PIELD AND LABORATORY STUDIES OF THE SULPHATE RESISTANCE ON

POTOMAC RIVER PSTUARY RELATIVE IMPORTANCE OF VARIABLES IN WATER RESOURCES

POWERHOUSES UNIT SPACING OF HYDROELECTRIC MACHINES, 970-03783

PRECIDITATION EXTENSION OF PAINFALL RECORDS BY INTERSTATION CORRELATION, W70-03932

PRECIPITATION (ATMOSPHERIC)
POINT RAINFAIL PRECUENCIES IN CONVECTIVE STORMS,
W70-03673
02R

AN ANALYSIS OF RUNS OF PRECIPITATION EVENTS, #70-03702 07C

SUNSPOTS AND HYDROLOGIC TIME SERTFS, W70-03712 02A

ELFVATTON EFFECTS ON RAINFALL NEAF HOLLIS, ALASKA, W70-03920 02B

PREFERENCE OPDERING
ON INDEPENDENCE POSTULATES CONCERNING CHOICE,
W70-03832 068

PREPRENCES (WATER RIGHTS)
MINERAL RIGHTS VERSUS WATER RIGHTS,
W70-03735

PRESPNT VALUE
A COMPARATIVE ANALYSTS OF THE NET PRESENT VALUE AND THE
BENEFIT-COST RATIO AS MEASURES OF THE ECONOMIC DESIRABILITY
OF INVESTMENTS,
W70-03825
068

WASTEWATER RATES AND SERVICE CHARGES IN GREAT BRITAIN, #70-03875

PRIMARY CLARIFIER
DIPLOGASTERID AND RHARDITID NEMATODES IN A WASTEWATER
TREATMENT PLANT,
N70-03925
05D

PRIMARY PRODUCTIVITY
PRINCIPLES OF PRIMARY PRODUCTIVITY
COMPLETELY NATURAL CONDITIONS,
W70-03965
02K

PACTORS INFLUENCING ALGAL PRODUCTIVITY IN DPER CREEK RESERVOIR, UTAH, W70-03986 02H

PRIVATE COSTS
ECONOMIC ANALYSIS IN WATER QUALITY MANAGEMENT,
W70-04000 06B

PROBABILITY
DETERMINATION OF OPTIMAL FLOOD PROTECTION LEVELS WITH SMALL EXCEPDANCE PROBABILITIES,
W70-03653
06A

USE OF THE CRITICAL PEPIOD IN RESERVOIR ANALYSIS, 970-03655

ESTIMATION OF THE PARAMETERS OF GUMBEL'S THIRD ASYMPTOTIC DISTRIBUTION BY DIFFERENT METHODS, W70-03674

A MOSAIC TECHNIQUE FOR GENERATING THE DAILY PATTERN SITHIN A SYNTHETIC FLOW SPONENCE, W70-03704 02A

ON THE EXTREME VALUE DISTRIBUTION FOR DESCRIBING ANNUAL FLOOD SERIES, 400-25

A PPAK DISCHARGE RELATION FOR INTERMEDIATE DEALWAGE BASIMS, W70-03855

EPPECTS OF SAMPLING INTERVAL, PERTODICITY, DEPENDENCE AND SKEWNESS ON FXTTEME VALUES, W70-03910 02P

PRODUCTION CONSUMPTION, AND EXTERNALITIES,

W70-03843

PRODUCTION FUNCTION
FUNCTIONS FOR COTTON (GOSSTPIUM HIRSUTUM L.) PRODUCTION FROM
IRRIGATION AND NITROGEN FERTILIZATION VARIABLES II. YIELD
COMPONENTS AND QUALITY CHARACTERISTICS,
H70-03805

06B

PUNCTIONS POR COTTON (GOSSYPIUM HIRSUTUM L.) PRODUCTION FROM IRRIGATION AND NITROGEN PERTILIZATION VARIABLES I. YIELD AND EVAPOTRANSPIRATION,

AN EXAMINATION OF LINEAR HOMOGENEITY OF TRADE AND PRODUCTION FUNCTIONS IN COUNTY LEONTIEF HATRICES, W70-03824

PRODUCTION FUNCTIONS
RETURNS TO SCALE AND COST CURVES,
W70-03844

PRODUCTIVITY

CONCEPTS OF EUTROPHICATION AND TROPHIC BIOLOGY,

W70-03959

02H

PRODUCTIVITY OF RIVERS, W70-03979

PROFITS
INVESTMENT RETURNS BEFORE AND AFTER TAX,
W70-03827
06

PROJECT PLANNING LEVEE DISTRICTS. W70-04021 04A

NATIONAL RIVERS AND HARBORS CONGRESS SUPPORTS A COMPREHENSIVE WATER RESOURCES DEVELOPMENT PROGRAM, W70-04043

PROSPECTIVE VALUE
MAXIMUM PROSPECTIVE VALUE CRITERION,
W70-03828

PROTEIN FOAM
LIGHT WATER AND PROTEIN FOAM.
W70-03813

YIELD-PROTEIN RELATIONSHIPS IN WHEAT GRAIN, AS APPECTED BY NITROGEN AND WATER, W70-03800

PSYCHOLOGICAL ASPECTS
THRORIES OF DECISION-MAKING IN ECONOMICS AND BEHAVIORAL W70-03991

PUBLIC BENEFITS
ESTABLISHMENT OF FREE PERRIES.
W70-03774

PUBLIC BEALTH SEWERAGE - WATER WORKS. W70-04025

PUBLIC RIGHTS
FLORIDA'S LAKES (NAVIGABILITY AND PUBLIC RIGHTS),
W70-04014
06E

PLORIDA'S LAKES (TESTS OF NAVIGABILITY), W70-04015

FLORIDA'S LAKES (RIGHTS IN LAKES), W70-04016

PLORIDA'S LAKES (RIGHTS OF THE PUBLIC), W70-04018

PUBLIC UTILITIES
POWERS UNDER CITY HANAGER CHARTER.
W70-03749

HEALTH AND SAFETY (PUBLIC WATER SUPPLY AND SEWER SYSTEM). W70-03780

PUBLIC UTILITIES. W70-04035

TAXATION OF BRIDGE AND PUBLIC UTILITY COMPANIES. W70-04042

PUBLIC UTILITY DISTRICTS
SEWER DISTRICTS (CONSTRUCTION OF SEWERS IN UNINCORPORATED
JURISDICTIONS).

PULSE INPUT TECHNIQUE
A BREAKTHROUGH IN THE TRACER STUDIES OF SEDIMENTATION TANKS,
W70-03922
O5D

QUARANTINES
CITTES OF THIRD CLASS (POWER TO REGULATE LEVEES).
W70-04038

OUARRYING
A MATHEMATICAL MODEL FOR PIT SLOPE STABILITY,
088

QUARTZ
THE INFRA-RED DETERMINATION OF QUARTZ IN SEDIMENTS AND

SUBJECT INDEX

SEDIMENTARY ROCKS, W70-03678 07B QUARTZ ADSORPTION BAND
THE INFRA-RED DETERMINATION OF QUARTZ IN SEDIMENTS AND
SEDIMENTARY HOCKS,
W70-03678
07B RADIOACTIVE AEFOSOLS
A NUMERICAL MODEL FOR THE HYDROLOGIC TRANSPORT OF BADIOACTIVE AEROSOLS FROM PRECIPITATION TO WATER SUPPLIES,

02A RADIOACTIVE DATING RADIOCARBON DETERMINATIONS APPLIED TO GROUNDWATER HYDROLOGY, 02F RADIOCARBON AGES OF GROUNDWATER IN AN ARID ZONE UNCONFINED AQUIFER, W70-03895 FRACTIONATION OF TRITIUM AND DEUTERIUM IN SOIL WATER, W70-03897 RADIOACTIVITY
MARINE RADIOECOLOGY, W70-03956 RADIOACTIVITY TECHNIQUES
DEVELOPMENT OF A RADIOISOTOPE GAGE FOR MONITORING SEDIMENT
CONCENTRATION IN RIVERS AND STREAMS,
W70-03687
07B THE APPLICATION OF ISOTOPES TO SOME PROBLEMS IN ATMOSPHERIC DIFFUSIOPHORFTIC AND THERMOPHORETIC EFFECTS ON PARTICULATE MATTER MEAR CONDENSING AND EVAPORATING WATER SURFACES, THE ATMOSPHERIC TRANSPORT OF TRITIUM, W70-03692 02B HURRICANE TRITIUM F PRELIMINARY RESULTS ON HILDA 1964 AND BETSY 1965, W70-03693 . 02B CONTRIBUTION OF ISOTOPE TECHNIQUES TO THE STUDY OF SOME HYDROLOGICAL PROBLEMS, THE USE OF RADIOACTIVE TRACER GASES TO STUDY THE RATE OF EXCHANGE OF WATER VAPOR BETWEEN AIR AND NATURAL SURFACES, $\text{W}70-016\,95$ APPLICATION OF DRUTFRIUM ANALYSES TO THE HYDROLOGY OF THE LAKES OF THE GRAND COULER, WASHINGTON, 970-0366 02K ULTRA-LOW VELOCITY MEASUREMENT IN A STRATIFIED RESERVOIR BY ISOTOPIC CURRENT METER, W70-03697 02H A NUMERICAL MODEL FOR THE HYDROLOGIC TRANSPORT OF RADIOACTIVE APPOSOLS FROM PRECIPITATION TO WATER SUPPLIES, W70-03698 DEVELOPMENT OF ISOTOPE METHODS APPLIED TO GROUNDWATER GROUNDWATER FLOW AND DIRECTION MEASURPMENT BY MEANS OF RADIOISOTOPES IN A SINGLE WELL, USE OF CHEMICAL AND RADIOACTIVE TRACERS AT THE NATIONAL REACTOR TESTING STATION, IDAHO, LARGE-SCALE DTILIZATION OF TRITIUM IN HYDROLOGIC STUDIES, W70-03894

ENVIRONMENTAL TRITIUM STUDIES AT THE NATIONAL REACTOR TESTING STATION, W70-03898 RADIOECOLOGY

MARINE RADIOFCOLOGY,

W70-03956

RADIOISOTOPES
THE APPLICATION OF ISOTOPES TO SOME PROBLEMS IN ATMOSPHERIC SCIENCES,
W70-03690 02B

THE ATMOSPHERIC TRANSPORT OF TRITIUM, 970-03692 02B

HURRICANE TRITIUM I PRELIMINARY RESULTS ON HILDA 1964 AND BEESY 1965, W70-03693 OZB CONTRIBUTION OF ISOTOPE TECHNIQUES TO THE STUDY OF SOME HYDROLOGICAL PROBLEMS, W70-03694

THE USE OF RADIOACTIVE TRACER GASES TO STUDY THE RATE OF EXCHANGE OF WATER VAPOR BETWEEN AIR AND NATURAL SURFACES, W70-03695 02C

ULTRA-LOW VELOCITY MEASUREMENT IN A STRATFFIED RESERVOIR BY ISOTOPIC CURRENT METER, W70-03697

DEVELOPMENT OF ISOTOPE METHODS APPLIED TO GROUNDWATER W70-03891

GROUNDWATER FLOW AND DIRECTION MEASUREMENT BY MEANS OF RADIOTSOTOPES IN A SINGLE WELL,

02F
02F

LARGE-SCALE UTILIZATION OF TRITIUM IN HYDROLOGIC STUDIES, W70-03894

TECHNIQUES OF GROUNDWATER TRACING USING RADIONUCLIDES,

ENVIRONMENTAL TRITIUM STUDIES AT THE NATIONAL REACTOR TESTING STATION, W70-03898

WATER TRACING IN THE HYDROLOGIC CYCLE, W70-03900 02A

RADIOSOTOPES
DESIGN OF A NEUTRON SCATTERING WATER CONTENT GAGE FOR SOILS, W70-03686

RAIN GAGES
POINT RAINFALL FREQUENCIES IN CONVECTIVE STORMS,
W70-03673
02B

A MODEL FOR GENERATING SYNTHETIC SEQUENCES OF SHORT-TIME-INTERVAL RAINFALL DEPTHS, W70-03703 02B

ELEVATION EFFECTS ON BAINFALL NEAR HOLLIS, ALASKA, 970-03820 02B

RAINFALL DISPOSITION
POINT RAINFALL FREQUENCIES IN CONVECTIVE STORMS,
W70-03673
02B

RAINPALL-RUNOPP RELATIONSHIPS
A MOSAIC TECHNIQUE FOR GENERATING THE DAILY PATTERN WITHIN A SYNTHETIC FLOW SEQUENCE, #70-03704

02A

CYCLIC FLUCTUATIONS OF VARIABILITY IN HYDROLOGIC PHENOMENA, 970-03711

RUNOFF INDUCEMENT IN ARID LANDS, W70-03809 0.38

SECTION I, INTRODUCTION SECTION II, DETERMINATION OF DESIGN DISCRARGE SECTION IX, APPENDIX. W70-03815

A WORKING HODEL FOR THE VARIATION IN STREAM WATER CHEMISTRY AT THE RUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE, W70-03867

ERRORS IN DISCHARGE ESTIMATES ON MOUNTAIN STREAMS, W70-03889

THE BAYES METHODS OF STATISTICAL HYDROLOGY (FRENCH), #70-03906

A PRINCIPAL COMPONENT ANALYSIS OF SURFACE RUNOFF DATA FROM A NEW ZFALAND ALPINE WATERSHED, W70-03908 02E

APPLICATION OF RUBS TO HYDROLOGIC DROUGHTS,

RANDOM-WALK MODELS
CONSTRAINED RANDOM WALK MEANDER GENERATION,
02B

RATE OF RETURN
INVESTMENT RETURNS BEFORE AND AFTER TAX,
06B

WASTEWATER RATES AND SERVICE CHARGES IN GREAT BRITAIN, W70-03875 06E

REAL PROPERTY
DUTIES OF DIRECTOR OF PUBLIC WORKS REGARDING SWAMP LANDS. #70-03740 06E

RECREATION
COUNTY FISHING LAKES AND RECREATION GROUNDS.
W70-03745
06E

TOWN OF PALM BEACH V CARTER (PROHIBITION OF SURPING WITHIN TOWN LIMITS FOUND CONSTITUTIONAL).

MISSOURI PEDERAL WATER PROJECTS RECREATION FUND. W70-03771 06C

LIABILITY OF LANDOWNER TO PERSONS USING LAND.

RECLAIMED WASTEWATER FOR SANTEE RECREATIONAL LAKES, W70-03950

RECREATION DEMAND

W70-04016	06E
RECREATION FACILITIES COUNTY FISHING LAKES AND RECREATION GI W70-03745	065
RECLAIMED WASTEWATER FOR SANTEE RECREMENTO-03950	ATIONAL LAKES, OSD
REGIMP MOBILE-BED PLHVIOLOGY, W70-03669	02J
REGIONAL ANALYSTS THE OPTIMALITY OF LOCAL SUBSIDIES IN I	REGIONAL DEVELOPMENT
PROGRAMS, W70-03838	06В
PEGGRESSION ANALYSIS SIMULATION MODEL FOR FLOW AUGMENTATION W70-03940	N COSTS, 05G
REGULATION CORPORATE POWERS (REGULATION OF WATER	SUPPLY - FLOOD
CONTROL). #70-03685	04 A
HUBTING AND PISHING REGULATIONS. W70-03777	06R
PISH AND GAME (EMPORCEMENT OF GAME AND	
W70-03778	062
CITIES OF THIRD CLASS (POWER TO REGULE W70-04038	ATE LEVEES). 04%
REMAINS EVIDENCE FOR EUTROPHICATION FROM REMAI	INS OF ORGANISMS TN
SPDIMPNTS, W70-03977	02म
REMEDIES COPPECTION OF PERORS IN ASSESSING DRAM W70-03742	INAGE DISTRICT LANDS.
REMOTE SENSING THE USE OF REMOTE SENSING IN WATER RES W70-03985	SOURCE MANAGEMENT,
RESEARCH AND DEVELOPHENT ON SUBSTDETES TO SPRED THE RATE AT WHICE DEVELOPED, W70-03830	CH TECHNOLOGIES ARE
RESERVOIR DESIGN APPLICATIONS OF MONTE CARLO METHOD TO W70-03713	RESERVOIR DESIGN, 02a
PVALUATION OF EXCEPDANCE PROBABILITY (PROTECTION NORKS IN RIVER, W70-03886	
RESERVOIR SYSTEM DRSIGN OPTIMIZATION,	04A ·
W70-03941	048
RESERVOIR OPERATION ON THE PLUCTUATION OF WATER RESOURCES, W70-03705	02a
STOCHASTIC ASPECTS OF RESERVOIR STORAG	SE,
W70-03706	02a
EVALUATION OF EXCPEDANCE PROPABILITY (PROTECTION WORKS IN RIVER, W70-03886	OF FLOOD FOR FLOOD-
RESERVOIR SILTING	***
SOME PROPOSALS OF THE STOCHASTIC METHODEPOSITS IN RESERVOIRS, W70-03709	OD OF FORECASTING FOR
RESERVOIR YIELD	
APPLICATIONS OF HONTE CARLO HETHOD TO #70-03713	RESERVOIR DESIGN, 02A
PESERVOIRS ULTRA-LOW VELOCITY HEASUREMENT IN A STISOTOPIC CURRENT METER,	TRATIFIED PRSPRVOIR BY
W70-03697	02н
RESULTS OF LIMNOLOGICAL INVESTIGATIONS RESPROOFS IN THE MORAVA RIVER BASIN, W70-03715	ON THE VALLEY
THERMAL DISCHARGE AND WATER QUALITY IN RESERVOIR, W70-03845	N A 1,500-ACRE
PACTORS INPLHENCING ALGAL PRODUCTIVITY BESERVOIR, UTAH, W70-03986	Y IN DEER CREEK
RESOURCE ALLOCATION SUPPRESS OF ECONOMIC THEORY, RESOURCE W70-03990	ALLOCATION, VOLUME ITT.
RESOURCE DEVELOPMENT	DECOUDER DE
ADMINISTRATIVE ARRANGEMENTS FOR WATER TN MONTANA, W70-04044	RESOURCES DEVELOPMENT

```
RESOURCE ECONOMICS UNORTHODOX,
                                                            068
   SOIL RESPIRATORY ACTIVITY AND ORGANIC NATTER DEPLETION IN AN ARTD NEVADA SOIL, 870-03801
   ADMINISTRATIVE ARRANGEMENTS FOR WATER RESOURCES DEVELOPMENT
IN MORTANA,
870-04044
  A GENERALIZATION OF THE CES PRODUCTION FUNCTION, W70-03829 06A
RETURNS TO SCALE
RETURNS TO SCALE AND COST CURVES,
W70-03844
                                                        . 06C
REVERSE OSMOSIS
RESEARCH AND DEVELOPMENT ON LOW PRESSURE REVERSE OSMOSIS
HEMBRANES AND DESIGN OF A SHALL UNIT FOR BRACKISH WATER,
W70-03667
  TECHNOLOGY OF SEA WATER DESALINATION, 03A
REVIEWS
PRACTURE OF LAKE AND SEA ICE,
W70-03651
                                                           02C
  DISCRIMINATING THE CHANGE IN MEANS OF HYDROLOGIC VARIABLES,
RHABDITID
DIPLOGASTERID AND RHABDITID MEMATODES IN A WASTEWATER
   TREATHFUT PLANT, W70-03925
   SUBMERGENCE EFFECTS ON A RHODE ISLAND BARRIER AND LAGOON AND INFERENCES ON MIGRATION OF BARRIERS, 970-03847
RIGHT-OF-WAY
  BRIDGFS.
W70-03750
   INSTITUTIONAL PACTORS AFFECTING LAND AND WATER DEVPLOPMENT,
LOWER RIO GRANDE VALLEY, TEXAS,
W70-03865
RIPARIAN RIGHTS
FLORIDA'S LAKES (RIGHTS ATTRIBUTABLE TO MAVIGABLE LAKES), W70-04017
06E
  COPING WITH UNCERTAINTY IN THE MAKE OR BUY DECISION, W70-03926
RIVER BASIN COMMISSIONS
WATERSHED DISTRICTS.
H70-03772
                                                            04 D
  W70-03917
                                                            04D
RIVER BASINS
CALCULATION OF HAXINUM DISCHARGES OF CRIMEAN RIVERS
   RUNOFF VOLUME AND HAXIBUM DISCHARGES OF SPRING PLOODS APPLIED TO THE UNSTUDIED RIVERS OF KALININGRADSK BEGION
                                                            028
   METHODS FOR THE DETERMINATION OF HAXINGH SHOW RESERVES IN
THE RIVER BASINS OF THE CENTRAL CHERNOZEM (BLACK FARTH) BELT
(RUSSIAM), 770-03684 02C
   STOCHASTIC STUDY OF CHANNEL DISTRIBUTION IN RIVER BASINS, 970-03707
  STATISTICAL CONSIDERATION IN RIVER MORPHOLOGY, W70-03708
RIVER FLOW

REDUCTION OF ANNUAL RIVER FLOWS TO LONGER PERIODS (RUSSIAN),

N70-03681

02E
   RUMOPP VOLUME AND BAXIBUM DISCHARGES OF SPRING PLOODS APPLIED TO THE UNSTUDIED RIVERS OF KALIHINGRADSK REGION (RUSSIAN), W70-03693
BIVER TRENT
TRENT BASIN STOCHASTICS,
W70-03902
                                                      028
RIVERS
PUBLIC PARKS, FORESTS AND RECREATION.
W70-03746
   PRODUCTIVITY OF RIVERS, W70-03979
```

TO

ROCK EXCAVATION ROCK CUTTING RESEARCH FOR THE DESIGN AND OPERATION OF TUNNELLING MACHINES, W70-03793	SEA WATER STABILITY OF CALCIUM CARBONATE POLYMORPHS IN WARM, SHALLOW SEAWATER, H70-03672 02K
ROCK SLOPE STABILITY A MATHEMATICAL MODEL FOR PIT SLOPE STABILITY, W70-03794 OBF	SEAWATER THE RESPONSE OF NATURAL MICROBIAL POPULATIONS IN SEAWATER TO ORGANIC ENRICHMENT, W70-03967 05C
ROCKSLIDES A MATHEMATICAL MODEL FOR PIT SLOPE STABILITY, W70-03794 08E	SECONDARY CLARIFIERS DIPLOGASTERID AND RHABDITID MEMATODES IN A WASTEWATER TREATMENT PLANT,
ROUTING THE DETERMINATION OF LOCAL INFLOWS ENTERING A CHANNEL, W70-03699 02F	#70-03925 O5D SEDIMENT DISCHARGE DEVELOPMENT OF A RADIOISOTOPE GAGE FOR MONITORING SEDIMENT
RUNOFF SUNSPOTS AND HYDPOLOGIC TIME SERIES, #70-03712 02A	CONCENTRATION IN RIVERS AND STREAMS, W70-03687 O7B SEDIMENT DISTRIBUTION
RUNOFF COEFFICIPNT SECTION I, INTRODUCTION SECTION II, DETERMINATION OF DESIGN DISCHAPGE SECTION IX, APPENDIX.	AN ERROR FUNCTION DESCRIPTION OF THE VERTICAL SUSPENDED SEDIMENT DISTRIBUTION, W70-03873
W70-03815 08A	SEDIMENT TRANSPORT UNIFICATION OF DATA ON SEDIMENT TRANSPORT IN FLUMES BY
SALINE WATER DISTRIBUTION OF CHLORIDES IN AN IRRIGATED CITRUS ORCHARD, W70-03799 03C	SIMILITUDE PRINCIPLES, W70-03874 02J
ROOTZONE SALT PROFILES AND ALFALPA GROWTH AS INFLUENCED BY IRRIGATION WATER SALINITY AND LEACHING PRACTION, W70-03807	SEDIMENT YIELD SECOND THE CENTRAL COLORADO SMOW ZONE, W70-03821
REGIONAL VAPIATIONS OF RIVER WATER COMPOSITION RESULTING PROM HALLTE SOLUTION, MACKENZIR RIVER DRAINAGE BASIN, CANADA, 970-03860	SEDIMENTARY STRUCTURES EOLIAN MICRORIDGES ON MODERN BEACHES AND A POSSIBLE ANCIENT EXAMPLE, W70-03661 02L
THERMO-ECONOMICS OF SALINE WATER CONVERSION,	SEDIMENTATION MOBILE-BED FLUVIOLOGY,
W70-03935 . 03A	¥70-03669 02J
TECHNOLOGY OF SEA WATER DESALINATION, W70-03946 03A	SOME PROPOSALS OF THE STOCHASTIC METHOD OF FORECASTING FOR DEPOSITS IN RESERVOIRS, W70-03709 02J
SALTNE WATER INTERSION IPCONING OP FRESH WATER-SEA WATER INTERFACE BELOW PUMPING WELLS, FIRLD STUDY, W70-03677 048	SUBMERGENCE EFFECTS ON A RHODE ISLAND BARRIER AND LAGOON AND INFERFNCES ON MIGRATION OF BARRIERS, W70-03847
SALTHE WATER-PRESHWATER INTERPACES UPCONING OF FRESH WATER-SEA WATER INTERPACE EPLOW PUMPING WELLS, FIELD STUDY,	TUBE CLARIFICATION PROCESS, OPERATING EXPERIENCES, W70-03911 05D
W70-03677	A BREAKTHROUGH IN THE TRACER STUDIES OF SEDIMENTATION TANKS, W70-03922 05D
SALINITY STATISTICAL EVALUATION OF SALINITY AND NITRATE CONTENT AND TRENDS BENEATH URBAN AND AGRICULTURAL AREA-PRESNO, CALIFORNIA, W70-03649 058	SEDIMENTS GAMMA-RAY SPECTROSCOPY AS A TOOL FOR A RAPID INVESTIGATION OF DETRITIC CORES, W70-03650 07B
DIFFUSION AND ENTRAINMENT IN TWO-LAYER FLOW, W70-03728 08B	THE INFRA-RED DETERMINATION OF QUARTZ IN SEDIMENTS AND SEDIMENTARY ROCKS, W70-03678
SALTS 'SALT-BISCUITS' - A SPECIAL GROWTH STRUCTURE OF NACL IN SALT SEDIMENTS OF THE TUX GOLU ('SALT LAKE'), TURKEY, W70-03671 02R	TUBE CLARIFICATION PROCESS, OPERATING EXPERIENCES, W70-03911 05D
SAMPLING A BATTERY POWERED PROPORTIONAL STREAM WATER SAMPLER, 970-03855 078	EVIDENCE FOR EUTROPHICATION FROM REMAINS OF ORGANISMS IN SEDIMENTS, W70-03977 02H
A TEN-UNIT WATER LEVEL SENSING AND RECORDING SYSTEM, W70-03857 07B	SEDIMENT-WATER INTERPACES SEDIMENT-WATER NUTRIENT INTERCHANGE, W70-03980 02H
SANDS . EOLIAN MICRORIDGES ON MODERN BEACHES AND A POSSIBLE ANCIENT EXAMPLE, W70-03661 021.	SENSITIVITY ANALYSIS RELATIVE IMPORTANCE OF VARIABLES IN WATER RESOURCES PLANNING, W70-03656 068
SANITARY DISTRICTS SANITARY DRAINAGE DISTRICTS-CITIES OVER 300,000 INHABITANTS AND ADJOINING COUNTIES. W70-03768 05G	SEWAGE REMOVAL OF SEWAGE NUTRIENTS BY ELECTROLYTIC TREATMENT, W70-03972 05D
SANITARY PRIGIPPERING SEWER DISTRICTS ST. LOUTS COUNTY.	PRIVATE SEWERS. W70-04040 05g
W70-03767 05G SANITARY DRAINAGE DISTRICTS-CITIES OVER 300,000 INHABITANTS	SEWAGE DISPOSAL PRIVATE SEWER SYSTEMS. W70-03736 05G
AND ADJOINING COUNTIES. W70-03768	CLASS TWO COUNTIES - SEWER DISTRICTS. W70-0402% 06E
SATURATED FLOW MECHANICS OF THE MOVEMENT OF MOISTURE AND CHEMICAL SUBSTANCES IN SOILS,	GENERAL SEWER SYSTEM. v70-04033 · 05G
W70-03881 02G	PRIVATE SEWERS. W70-0403W 05G
THE USE OF A TRACER TEST TO VERIFY AN ESTIMATE OF THE GROUNDWATER VPLOCITY IN PRACTURED CRYSTALLINE ROCK AT THE SAVANNAH RIVER PLANT NEAR AIKEN, SOUTH CAROLINA, W70-03899	SEWAGP DISTRICTS SEWER DISTRICTS. W70-03737 05G
CC PURD PC HIS	SEWER DISTRICTS ST. LOUIS COUNTY.
A METHOD FOR PREDICTING THE EFFECTS OF LIGHT INTENSITY ON ALGAL GROWTH AND PHOSPHOROUS ASSIMILATION,	W70-03767 05G
#70-03923 05C	LIQUIDATOR FOR SEWER DISTRICTS IN CERTAIN COUNTIES. W70-03769 O5G

SEWER DISTRICTS (CONSTRUCTION OF SEWERS IN UNINCORPORATED JURISDICTIONS) : CLASS TWO COUNTIES - SEWER DISTRICTS. #70-04024 SEWFRAGE - WATER WORKS. W70-04025 05G PRIVATE SEWFPS. #70-04034 SEWAGE EFFLUENTS REMOVAL OF SEWAGE BUTRIENTS BY ELECTROLYTIC TREATMENT, W70-03972 05D DIALYSTS SEPARATION OF SEWAGE SLUDGE DIGESTION, #70-03929 05D SEWAGE TREATHENT
PHYSICOCHEMICAL TREATHERT OF WASTEWATER,
050 USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES CHAPTER III, W70-03933 058 STHULATION MODEL FOR PLOW AUGMENTATION COSTS, W70-03940 05G REMOVAL OF SEWAGE NUTRIENTS BY ELECTROLYTIC TREATMENT, W70-03972 CLASS TWO COUNTIES - SEWER DISTRICTS.
W70-04024 06E SEWER DISTRICTS
CLASS TWO COUNTIES - SEWER DISTRICTS.
06E SEWERAGE - WATER WORKS. W70-04025 SEWER DISTRICTS. W70-03737 056 SEWERS AND WATPRWORKS. W70-03748 SANITARY DRAINAGE DISTRICTS-CITTES OVER 300,000 INHABITANTS AND ADJOINING COUNTIES. 05G SEWER DISTRICTS (CONSTRUCTION OF SEWERS IN UNTINCORPORATED JURISDICTIONS). W70-040-23 06P. PRIVATE SEWERS. W70-04040 056 STALLOW WATER
STABILITY OF CALCIUM CARBONATE POLYMORPHS IN WARM, SHALLOW
SPAWATER,
W70-03672
02K SHALLOW-DEPTH-SEDIMENTATION TUBE CLARIFICATION PROCESS, OPERATING EXPERIENCES, 970-03911 05D STRULATED RATHFALL
A MODEL FOR GENERATING SYNTHETIC SEQUENCES OF SHORT-TIME-INTERVAL RAIMFALL DEPTHS,
P70-03703
02B SIMULATION ANALYSIS
SIMULATION MODEL FOR FLOW AUGMENTATION COSTS,
W70-03940
05G SKULL VALLEY (UTAB)
HYDROLOGIC RECONNAISSANCE OF SKULL VALLEY, TOOPLE COUNTY, SITCES
SUPPACE SLICES AS CONCENTRATORS OF PRESTICIDES IN THE MARTINE
PNYIROWMENT,
U70-03953
05a SLOPE STABILITY
A MATHEMATICAL MODEL FOR PIT SLOPE STABILITY, #70-03794 08E SLUDGE REMOVAL OF SEWAGE NUTRIENTS BY ELECTROLYTIC TREATMENT, W70-03972 05D SLUDGE DEWSTTY INDEX
GRAVITY THICKENERS FOR ACTIVATED SLUDGE,
#70-03914 05D SLUDGE DISPOSAL.
BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCRAN
DISPOSAL SITES VOLUME I - THE WASTE MANAGEMENT CONCEPT.
W70-04005

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCFAN DISPOSAL SITES VOLUME II - CRITERIA FOR WASTE MANAGEMENT,

#70-04006 BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES WOLUME III - TECHNICAL ASPECTS OF PIPELINING OF WASTE MATERIALS, W70-04007 05E SLUDGE VOLUME INDEX
GRAVITY THICKENERS FOR ACTIVATED SLUDGE,
W70-03914 05D SLUDGE-VOLUME RATIO
GRAVITY THICKENERS FOR ACTIVATED SLUDGE,
#70-03914 05 SLURRIES
BULK TRANSPORT OF WASTE SLURBIES TO INLAND AND OCEAR
DISPOSAL SITES SUMMARY PEPORT,
05E BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES VOLUME III - TECHNICAL ASPECTS OF PIPELINING OF WASTE MATERIALS, SHALL WATERSHEDS

EFFECTS OF PLOOD PROTECTION ON LAND USE IN THE COON CREEK,
WISCONSIN, WATERSHED,
W70-03654

04A A WORKING MODEL FOR THE VARIATION IN STREAM WATER CHEMISTRY AT THE HUBBARD BROOK EXPERIMENTAL FOREST, WEW HARPSHIRE, W70-03867 PURPOSE AND PERPORMANCE OF PEAK PREDICTIONS, W70-03887 SNOW ALBEDO HODIFICATION - A REVIEW OF LITERATURE, BETHODS FOR THE DETERMINATION OF MAXIMUM SNOW RESERVES IN THE RIVER BASINS OF THE CENTRAL CHERNOZEM (BLACK FARTH) BELT (RUSSIAN), W70-03684 NOW CUTPR

METHODS FOR THE DETERMINATION OF MAXIMUM SNOW RESERVES IN THE RIVER BASINS OF THE CENTRAL CHEBNOZEM (BLACK EARTH) BELT (RUSSIAN), #70-03684 SNOW COVPR HETHODS FOR THE DETERMINATION OF MAXIMUM SHOW RESPRES IN THE RIVER BASIBS OF THE CENTRAL CHERNOZEM (BLACK EARTH) BELT SOCIAL ASPECTS
BIBLIOGRAPHY OF SOCIO-ECONOMIC ASPECTS OF WATER RESOURCES,
W70-03714
06B BENEFIT-COST ANALYSIS A CRITERION FOR SOCIAL INVESTMENT, W70-03999 06B SOCIAL COSTS
THE WATER SUPPLY SYSTEM UP TO A.D. 2001,
W70-03842
06C ECONOMIC ANALYSIS IN WATER QUALITY MANAGEMENT, W70-04000 068 WATER FOR WESTERN PEDERAL IRRIGATION PROJECTS, W70-03996 SOCIAL INVESTMENT
BENEFIT-COST ANALYSIS A CRITERION FOR SOCIAL INVESTMENT,
W70-03999 06B SOCIOECONONIC STATUS
SOCIOECONONIC STATUS
A RE-EXAMINATION OF ITS DIMENSIONS.
06B SODIUS CHLORIDE
'SALT-BISCUITS' - A SPECIAL GROWTH STRUCTURE OF MACL IN SALT
SEDTHEMYS OF THE TUZ GOLU ('SALT LAKE'), TURKEY,
W70-03671
02K SOIL COLUMNS
INFILTRATION, REDISTRIBUTION, AND SUBSEQUENT EVAPORATION OF WATER FROM SOIL AS APPECTED BY WETTING RATE AND HYSTERESIS, W70-03852
O2G
O2G SOIL CONSERVATION SOIL AND WATER CONSERVATION DISTRICTS. #70-03918 04D HISSOURI SOIL AND WATER CONSERVATION DISTRICTS LAW. W70-04041 SOIL MICROORGANISMS
SOIL RESPIRATORY ACTIVITY AND ORGANIC NATTER DEPLETION IN AN ARID NEVADA SOIL,
W70-03801
02G SOTE HOISTURE
DOWNWARD HOVEHENT OF SOIL MOISTURE TRACED BY MEANS OF
HYDROGEN ISOTOPES,
W70-03689
02G

							SUBJ:
	THE EFFECT RUNOFF AND W70-03884	OF SOIL MERCHARGE,	OISTURE ON	INFILTR	ATION AS	RELATED TO	
	RELATIONSHI EVAPOTRANSE	PS BETWEEN	N SOIL MOT	STURE AC	CTUAL AND	POTENTIAL	
~ .	W70-03885				020		
50	DIL MOTSTURE DESIGN OF A W70-03686	NEUTRON :	SCATTERING	WATER C	ONTENT GA	GE FOR SOI	LS,
	MINIMIZING ERRORS, W70-03787	NUCLEAR S	OTL DENSITY	Y AND MO	OISTURE CO	NTENT GAGE	
5 (CONSERVING	RESOURCES	AND MAINT	AINING A	QUALITY 058	ENVIRONMEN	T,
50	DIL SEALANTS	5			0.56		
	RUNOFF INDU W70-03809		ARID LANDS	5,	03B		
50	PRP-EQUILIE GULLY DAM, W70-03782	TY BRIUM OBSE.	RVATIONS O	THE RE	CONSTRUCT	ED FLAGSTA	FF
30	TL TREATMEN		ቸውቸው ሃ አውር /	DCANTC	Mamman no	DIPTION TH	7. M
	ARID NEVADA W7C-03801	SOTL,	TILL MID	AGRIC	02G	- ZHILON IN	n N
	I.ABOPATORY	TESTS OF	SPRAYABLE 1	MATERTAL	S FOR RUN	OPF	
	NOUCEMENT NO-03804	ON A LOES.	STAL SOIL,		02E		
sc	TL WATER MO		D NCE OF C	N 7 12 2 19 19		T 70	
	W70-03675				026		
	DOWNWARD MO HYDROGPN IS W70+03689	OVEMENT OF SOTOPES,	SOIL MOIS	TURE TRA	CED BY ME	CARS OF	
	SOTL PACTOR	S TNPLUEN	CING PERCO		EST PERFO	RMANCE,	
	W70-03850 NUMERICAL M	FTHOD FOR	ESTIMATING	- S STMULA		LOW OF WAT	ER
	AND SALT IN W70-03851	UNSATURA	ren sotts,		0 2 G		
	INFILTRATION WATER FROM W70-03852	ON, REDIST	RIBUTION, PRECTED BY	AND SHBS	EQUENT EV RATE AND 02G	APORATION HYSTERESI	OF S,
	COMPARISON POLLOWING T W70-03853				OTSTURE RE	DISTRIBUTI	ON
	THERMO-OSMO W70-03859	SIS THROU	GH COMPACTI	ED SATUR	ATED CLAY	MEMBRANES	,
	EVALUATION W70-03880	OF FLOW P	ARAMETERS,		02G		
	MECHANICS O SUBSTANCES		EMENT OF MO	TSTURE	AND CHEMI	CAI.	
	W70-03881				02G		
	ELECTRICAL UNSATURATED W70-03882			5,	TERS FOR	ESTIMATING	
	SIMILITUDE	FOR PARTIE	ALLY SATURA				
	W70-03883 RELATIONSHI				02G		
	FVAPOTRANSP W70-03885		SOIL WOL		020	POT TREE	
50	TLS INFILTRATIO WATER FROM W70-03852	N, RPDIST	RIBUTION, A	WETTING	EQUENT EV RATE AND 02G	APORATION HYSTERESI	OP S,
0	LITARY WAVE COMPUTER ST W70-04009	udies of f	FINITE-AMPI	.ITUDE W	ATER WAVE	S,	
	LVENT EXTRA FERMENTATIO VOLATILE AC W70-03921	N OF SPENT	SULFITE I		OR THE PR	ODUCTION O	F
	PPTION ANTONIC AND ALGAE CULTU W70-03928	NONIONIC RPS,	SURFACTANT		ON AND DE	GRADATION	ву
	OTH CAPOLIN THE USE OF GROUNDWATER SAVANNAH RI	A TRACER T	IN FRACTUR	ED CRYS'	TALLINE ROCAROLINA	OCK AT THE	
	W70-03899				027		

SOUTHWEST U

LARGE VOLUME - LONG DISTANCE PRESH WATER TRANSFPREAL AS AN ALTERNATE TO DESALINATION,

#70-03810

06D

SOT-STA UNIT SPACING OF HYDROELECTRIC MACHINES, W70-03783 08C SPECIFIC CAPACITY
COMPILATION OF RESULTS OF AQUIFER TESTS IN TEXAS,
02F SPECIFIC YIELD
DETERMINING SPECIFIC YIELD OF THE OGALLALA AQUIFER BY THE
NEUTRON METHOD,
W70-03871
02F SPECTRAL ANALYSIS
ON THE FLUCTUATION OF WATER RESOURCES,
#70-03705 02A SPECTROSCOPY
GAMMA-RAY SPECTROSCOPY AS A TOOL FOR A RAPID INVESTIGATION
OF DETRITIC CORRS,
.W70-03650
07B SPEED RIVER(ONTARIO)
DIEL AND SEASONAL VARIATIONS IN PHYSIOCHEMICAL LIMNOLOGY,
SPEED RIVER, ONTARIO,
W70-03861
02K SPOROCYTOPHAGA CAULIFORMIS
THE MYXOBACTERIA TYPE QUOTIENT AS AN INDICATOR OF EUTROPHICATION FOR SURFACE WATERS (IN GERMAN),
02H SPRAYS
WETTING AGENT TESTS.
W70-03812 030 LIGHT WATER AND PROTEIN FOAM. W70-03813 ESTIMATION OF THE PARAMETERS OF GUMBEL'S THIRD ASYMPTOTIC DISTRIBUTION BY DIFFERENT METHODS, W70-03674 AN ERROR MODEL FOR A SINGLE DISCHARGE MEASUREMENT, W70-03700 02E A PROPERTY OF THE RANGE OF PARTIAL SUMS, AN ANALYSIS OF RUNS OF PRECIPITATION EVENTS, w70-03702ON THE FLUCTUATION OF WATER RESOURCES, W70-03705 02A STOCHASTIC ASPECTS OF RESERVOIR STORAGE, SPRINKLER IRRIGATION EVAPORATIVE COOLING OF HEATED IRRIGATION WATER BY SPRINKLER APPLICATION, AN EVALUATION OF THREE COEFFICIENTS AS A MEASURE OF UNIFORMITY OF WATER APPLICATION BY SPRINKLERS, W70-03803 STANDARD DEVIATION
AN EVALUATION OF THREE COEFFICIENTS AS A MEASURE OF
UNIFORMITY OF WATER APPLICATION BY SPRINKLERS,
03F STATISTICAL METHODS

DPTERMINATION OF OPTIMAL PLOOD PROTECTION LEVELS WITH SMALL EXCREDANCE PROBABILITIES, W70-03653

06A SOME PROPOSALS OF THE STOCHASTIC METHOD OF PORECASTING FOR DEPOSITS IN RESERVOIRS, W70-03709 CYCLIC FLUCTUATIONS OF VARIABILITY IN HYDROLOGIC PHENOMENA, W70-03711 A METHOD FOR STATISTICAL EVALUATION OF WEATHER MODIFICATION AT THE RIVER FLOW CONTROL LEVEL, W70-03848 EVALUATION OF EXCEEDANCE PROBABILITY OF FLOOD FOR FLOOD-PROTECTION WORKS IN RIVER, W70-03886 PURPOSE AND PERFORMANCE OF PEAK PREDICTIONS, W70-03887 DISCRIMINATING THE CHANGE IN MEANS OF HYDROLOGIC VARIABLES, W70-03888 ABOUT THE ANALYTICAL METHOD FOR THE COMPILATION OF THE WATER BALANCE IN AGRICULTURE, W70-03901 02D GENERALIZED DROUGHT SEQUENCE PROBABILITIES FOR STORAGE-DRAFT FREQUENCY ANALYSIS,

A PRINCIPAL COMPONENT ANALYSIS OF SURFACE RUNOFF DATA FROM A NEW ZEALAND ALPINE WATERSHED, W70-03908

STA-SUR PEPECTS OF SAMPLING INTERVAL, PERIODICITY, DEPENDENCE AND SKEWNESS ON EXTREME VALUES, M70-03910 02F. STATISTICAL MODELS
USE OF THE CRITICAL PERIOD IN RESERVOIR ANALYSIS,
W70-03655
04A RELATIVE IMPORTANCE OF VARIABLES IN WATER RESOURCES PLANKING, 06B ESTIMATION OF STATISTICAL PARAMETERS FOR ANNUAL RIVER FLOWS, W70-03858 COMPARISON OF SMART AND SCHEIDEGGER STERAM LENGTH MODELS, 970-03862 CONSTRAINED RANDOM WALK MEANDER GENERATION, 970-03866 DISTRIBUTION OF INTERIOR LINK LENGTHS IN NATURAL CHANNEL STOCHASTIC PROCESSES
STOCHASTIC ASPECTS OF RESERVOIR STORAGE,
W70-03706 02A STOCHASTIC STUDY OF CHANNEL DISTRIBUTION IN RIVER BASINS, \$70-03707 02E STATISTICAL CONSIDERATION IN FIVER MORPHOLOGY, W70-03708 STOCHASTIC ASPPCTS OF LAKE ONTARIO EVAPORATION, W70-03872 02D TRENT BASIN STOCHASTICS, W70-03902 02E STORM DRAINS

DRAINAGE MASTER PLAN POR THE CITY OF FORT WORTH PUBLIC WORKS

DREARPHEAT, STORM DRAINAGE CRITERIA AND DESIGN MANUAL.

W70-03814 SECTION V, FLOW IN STORM DRAINS AND THEIR APPURTFNANCES SECTION VI, DESIGN OF CLOSED STORM DRAINAGE SYSTEM SECTION VII, DESIGN OF OPEN CHANNELS.

#70-03817 SECTION VIII, DESIGN OF CULVERTS. W70-03818 STORM RUNOPP
DRAINAGE MASTER PLAN FOR THE CITY OF POPT WORTH PURLIC WORKS
DEPARTMENT, STORM DRAINAGE CRITERIA AND DESIGN MANUAL.
W70-03814
088 SECTION III, PLOW IN GUTTERS SECTION IV, STORM DRAIN INLFTS. W70-03816 SECTION VIIT, DESIGN OF CULVERTS. W70-03818 STRATIFICATION
THERMAL CIRCULATION ON A ROTATING SPHERE WITH APPLICATION
TO THE OCFANIC THERMOCLINE,
W70-03725
02L STRATIPIED PLOW MOTION OF TWO DIMENSIONAL STARTING PLUME, W70-03731 OBB STREAM PROSION
CONSTRAINED PANDOM WALK MEANDER GENERATION,
W70-03866 02E STREAM LENGTH MODELS
COMPARISON OF SMART AND SCHEIDEGGER STREAM LENGTH MODELS,
W70-03862
02E STREAMPLOR
AN ERROR HODPL FOR A SINGLE DISCHARGE MPASUREMENT,
W70-03700 02P. A METHOD FOR STATISTICAL EVALUATION OF WEATHER MODIFICATION AT THE RIVER FLOW CONTROL LEVEL, 03B TRENT BASTN STOCHASTICS, #70-03902 STREAMPLOW PORECASTING
USE OF THE CRITICAL PERIOD IN RESERVOIR ANALYSIS,
W70-03655 ON THE FIGCTUATION OF WATER RESOURCES, W70-03705 STOCHASTIC ASPECTS OF RESERVOIR STORAGE, 870-03706 ADAPTIVE FILTERS FOR TREND EXTRAPOLATION OF RUNOFF RECORDS, N70-03710 CYCLIC PLUCTUATIONS OF VARIABILITY IN HYDROLOGIC PHENOMENA, #70-037.11

APPLICATIONS OF MONTE CAPLO METHOD TO RESERVOIR DESIGN,

ESTIMATION OF STATISTICAL PARAMETERS FOR ANNUAL RIVER FLOWS, W70-03858 EVALUATION OF EXCREDANCE PROBABILITY OF FLOOD FOR FLOOD-PROTECTION WORKS IN RIVER, DISCRIMINATING THE CHANGE IN MEANS OF HYDROLOGIC VARIABLES, W70-03888 ERRORS IN DISCHARGE ESTIMATES ON MOUNTAIN STREAMS, #70-03889 GENERALIZED DROUGHT SEQUENCE PROBABILITIES FOR STORAGE-DRAFT FREQUENCY ANALYSIS, W70-03904 EFFECTS OF INCONSISTENCY AND NON-HOMOGENEITY ON HYDROLOGIC TIME SERIES, W70-03905 APPLICATION OF RUNS TO HYDROLOGIC DROUGHTS. W70-03909 EPPECTS OF SAMPLING INTERVAL, PERIODICITY, DEPENDENCE AND SKEWNESS ON EXTREME VALUES, W70-03910 02E WATERCOURSES (ALTERATION FOR BRIDGE CONSTRUCTION). R70-03738 04A ESTABLISHMENT OF FREE FERRIES. W70-03774 STRRET FLORS
SECTION III, PLOW IN GUTTERS SECTION IV, STORM DRAIN INLETS. STRUCTURAL DESIGN
UNIT SPACING OF HYDROELECTRIC MACHINES,
#70-03783 08C STRUCTURES
PARTITION WHEN LAND BOUNDED BY WATER.
W70-03786 04A SUBHERGED LANDS ACT
THE TIDPLANDS CONTROVERSY AND LOUISLANA'S EXPERIENCE IN THE ON SUBSIDIES TO SPEED THE RATE AT WHICH TECHNOLOGIES ARE DEVELOPED, W70-03830 06B SULPATE ATTACK
FIELD AND LABORATORY STUDIES OF THE SULPHATE RESISTANCE ON SULFATE-RESISTING CEMENTS
FIELD AND LABORATORY STUDIES OF THE SULPHATE RESISTANCE ON SUNSPOTS
SUNSPOTS AND HYDROLOGIC TIME SERIES,
H70-03712
02A SUPERVISORY CONTROL (POWER)
MISSOURT--ILLINOIS BRIDGE COMMISSION.
W70-03753 06E SURPACE DRAINAGE
DRAINAGE MASTER PLAN FOR THE CITY OF FORT WORTH PUBLIC WORKS
DEPARTMENT, STORM DRAINAGE CRITERIA AND DESIGN MANUAL.
084
084 SECTION III, FLOW IN GUTTERS SECTION IV, STORM DRAIN INLETS. W70-03816 OBA SECTION VIII, DESIGN OF CULVERTS. W70-03818 084 DRAINAGE DISTRICTS ORGANIZED IN COUNTY COURT. N70-04020 SURFACE RUNOFF
LABORATORY TESTS OF SPRAYABLE MATERIALS FOR RUNOFF
INDUCEMENT ON A LOESSIAL SOIL,
W70-03804
Q2E THE EFFECT OF SOIL MOISTURE ON INFILTRATION AS RELATED TO RUNOFF AND RECHARGE, W70-03R84 02G SURPACE TENSION WETTING AGENT TESTS. W70-03812 SURFACE HATERS
SURFACE SLICKS AS CONCENTRATORS OF PESTICIDES IN THE MARINE ENVIRONMENT,
W70-03953
O5A 05A

02A

SUBJECT INDEX

05G

THE MYKOBACTERIA TYPE QUOTIENT AS AN INDICATOR OF EUTROPHICATION FOR SURFACE WATERS (IN GERMAN), W70-03963 GENERAL SEWER SYSTEM. W70-04033 SURPACE-GROUNDWATER RELATIONSHIPS
A WORKING HODEL FOR THE VARIATION IN STREAM WATER CHEMISTRY
AT THE HUBBARD BROOK EXPPRIMENTAL POPEST, NEW HAMPSHIRE,

02K TECHNOLOGY THE PFFFCT OF SOIL MOISTURE ON INPILTRATION AS RELATED TO RUNOFF AND RFCHARGE, ₩70-0388# SURFACTANT
LIGHT WATER AND PROTEIN FOAM.
W70-03813 SURPACTANTS WETTING AGENT TESTS. W70-03812 030 ANIONIC AND NONTONIC SURFACTANT SORPTION AND DEGRADATION BY ALGAE CULTURES, W70-03928 05D SURF-ROARDING
TOWN OF PALM BEACH V CARTER (PROHIBITION OF SURPING WITHIN
TOWN LIMITS FOUND CONSTITUTIONAL).

OAR CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO GROUNDWATER STATIONS, CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO AREAL INVESTIGATIONS AND MISCELLANEOUS ACTIVITIES, W70-03663 02E COLOR PHOTOGRAPHS FOR WATER RESOURCES STUDIES, W70-03680 078 APPLICATIONS OF COLOR ARRIAL PHOTOGRAPHY TO WATER PRSOURCES STUDIES, W70-03869 07B SUSPENDED LOAD

DEVELOPMENT OF A RADIOISOTOPE GAGE FOR MONITORING SEDIMENT
CONCENTRATION IN RIVERS AND STREAMS,

07B AN ERROR FUNCTION DESCRIPTION OF THE VERTICAL SUSPENDED SEDIMENT DISTRIBUTION, W70-03873 02J SWAMPS
DUTTES OF DIFFCTOR OF PUBLIC WORKS REGARDING SWAMP LANDS. #70-03740 06E SWAMP AND OVERPLOWED LAND. W70-03756 SWAMP AND OVERPLOWED LANDS (PATENTS AND CONTRACTS). SYNOPTIC ANALYSTS
DETERMINING AND MAPPING THE AVERAGE HYDROLOGIC RESPONSE OF EASTERN UNITED STATES, SYNTHESTS
TEMPERATURE FEFECTS ON ENERGY OXYGEN REQUIREMENTS IN BIOLOGICAL OXIDATION, W70-03919 SYNTHETIC HYDROLOGY A MODEL FOR GENERATING SYNTHETIC SEQUENCES OF SHORT-TIME-INTERVAL RAINFALL DEPTHS, #70-03703 A MOSAIC TECHNIQUE FOR GENERATING THE DAILY PATTERN WITHIN A SYNTHETIC PLOW SEQUENCE, W70-03704 SYSTEMS ANALYSIS EXAMINATION INTO THE EFFECTIVENESS OF THE CONSTRUCTION GRANT PROGRAM FOR ABATING, CONTROLLING AND PREVENTING WATER STRATEGY FOR MICHIGAN WATER RESOURCES MANAGEMENT A SYSTEMS APPROACH, W70-03944 WATER-HAMMER ATTENUATION WITH A TAPERED LINE, W70-03785 SEWER DISTRICTS ST. LOUIS COUNTY. W70-03767 INVESTMENT RETURNS BEFORE AND AFTER TAX, 170-03827 WASTEWATER RATES AND SERVICE CHARGES IN GREAT BRITAIN, W70-03875

06E

WATER CONSERVANCY DISTRICTS. W70-04031

TAXATION OF BRIDGE AND PUBLIC UTILITY COMPANIES. W70-04042 ON SUBSIDIES TO SPEED THE RATE AT WHICH TECHNOLOGIES ARE DEVELOPED, W70-03830 TEMPERATURE TEMPERATURE RELATIONSHIP IN AEROBIC TREATMENT AND DISPOSAL OF PULP AND PAPER WASTES, W70-03720 05D BIOLOGICAL EFFECTS OF HANFORD HEAT ON COLUMBIA RIVER FISHES W70-03721 THE RELATION OF TEMPERATURE TO OXYGEN CONSUMPTION IN THE GOLDFISH, GROWTH OF LARGEMOUTH BASS FRY AND VARIOUS TEMPERATURES, W70-03733 TEMPERATURE EFFECTS ON ENERGY OXYGEN REQUIREMENTS IN BIOLOGICAL OXIDATION, W70-03919 RELATION BETWEEN FILTERING RATE, TEMPERATURE, AND BODY SIZE IN FOUR SPECIES OF DAPHNIA, W70-03957 05C DRAINAGE AND LEVEE DISTRICTS. W70-03741 04 A CORRECTION OF ERRORS IN ASSESSING DRAINAGE DISTRICT LANDS. DRAINAGE DISTRICTS (CONSTRUCTION OF IMPROVEMENTS). WATERS, DRAINS, AND LEVEES (DISTRICTS IN MORE THAN ONE COUNTY).
W70-03744
04A COUNTY FISHING LAKES AND RECREATION GROUNDS. PUBLIC PARKS, FORESTS AND RECREATION. W70-03746 BOUNDARIES (STATE). W70-03747 068 SEWERS AND WATERWORKS. W70-03748 POWERS UNDER CITY MANAGER CHARTER. W70-03749 WATERSHED DISTRICTS. W70-03772 04D FORDS AND PUBLIC BRIDGES (CLEARING OF FORDS AND BUILDING OF W70-03773 ESTABLISHMENT OF FREE PERRIES. HIGHWAYS, BRIDGES AND FERRIES (PRIVATE AND LOCAL IMPROVEMENTS). #70-03775 FISH AND GAME. W70-03776 06B HUNTING AND PISHING REGULATIONS. FISH AND GAME (ENFORCEMENT OF GAME AND FISH LAWS). W70-03778 LIABILITY OF LANDOWNER TO PERSONS USING LAND. W70-03779 06E HEALTH AND SAFETY (PUBLIC WATER SUPPLY AND SEWER SYSTEM). W70-03780 TERRAIN ANALYSIS
DETERMINING AND MAPPING THE AVERAGE HIDROLOGIC RESPONSE OF EASTERN UNITED STATES, W70-04008
07C TERTIARY TREATMENT
RX FOR AILING LAKES--A LOW PHOSPHATE DIET,
02H TEST PROCEDURES

APPLICATION OF PORE PRESSURE MEASUREMENTS TO SHEAR STRENGTH

OF COHESIVE SOILS, FLOOD PLAIN INFORMATION, ROSILLO CREEK, BEXAR COUNTY, TEXAS. W70-03647 TEX-TRY COMPLIATION OF RESULTS OF AQUIFER TESTS IN TEXAS, $\mbox{W70-03660}$ THERMAL POLLUTION COOLING WATER SOURCES FOR POWER GENERATION, W70-03727 05D THERMAL DISCHARGE AND WATER QUALITY IN A 1,500-ACRE RESERVOIR, W70-03845 THERMAL PROPPRIES
DIFFISIOPHORETIC AND THERMOPHORETIC EFFECTS ON PARTICULATE
MATTER NEAR CONDENSING AND EVAPORATING WATER SURFACES,
W70-03691
028 THERMAL STRATTPICATION
ULTRA-LOW PELOCITY MEASUREMENT IN A STRATIPIED RESERVOIR BY
ISOTOPIC CURPENT METER,
W70-03697
02H THERMAL CIRCULATION ON A ROTATING SPHERE WITH APPLICATION TO THE OCEANIC THERMOCLINE, W70-03725 02L TREEMOCLINE
THERMAL CIPCULATION ON A ROTATING SPHERE WITH APPLICATION
TO THE OCEANIC THERMOCLINE,
02L NOTES ON THE THEORY OF THE THERMOCLINE, W70-03726 02L ON THE ROLES OF VERTICAL VELOCITY AND EDDY CONDUCTIVITY IN MAINTAINING A THERMOCLINE, ON THERMALLY MAINTAINED CIRCULATION IN A CLOSED OCEAN BASIN, W70-03732 021 THERMODYNAMICS
THERMO-ECONOMICS OF SALINE WATER CONVERSION,
03A THERMOHALINE
ON THERMALLY MAINTAINED CIRCULATION IN A CLOSED OCEAN BASIM, W70-03732
02L THICKENING
GRAVITY THICKPHERS FOR ACTIVATED SLUDGE,
#70-03914 05D THYMIDINF
BACTERIAL GROWTH RATE IN THE SEA DIRECT ANALYSIS BY
THYMIDINE AUTORADIOGRAPHY,
W70-03968
05C TIDAL WATERS
THE TIDELANDS CONTROVERSY AND LOUISIANA'S EXPERIENCE IN THE TIME OF CONCENTRATION
SECTION I, INTRODUCTION SECTION II, DETERMINATION OF DESIGN
DISCHARGE SECTION II, APPENDIX.
W70-03815
08A TIME SERIES ANALYSTS
A PROPERTY OF THE RANGE OF PARTIAL SUMS,
W70-03701 07A ON THE FLUCTUATION OF WATER RESOURCES, W70-03705 ADAPTIVE FILTERS FOR TREND EXTRAPOLATION OF RUNOFF RECORDS, N70-03710 SUNSPOTS AND HYDROLOGIC TIME SERIES, W70-03712APPLICATIONS OF MONTE CARLO METHOD TO RESERVOIR DESIGN, W70-03713 EPPECTS OF INCONSISTENCY AND NON-HOMOGENPITY ON HYDROLOGIC TIME SERIES, 02a APPLICATION OF RUNS TO HYDROLOGIC DROUGHTS, N70-03909 TOLL BRIDGES BRIDGES. 06E

TAXATION OF BRIDGE AND PUBLIC UTILITY COMPANIES. W70-04042 06R

TOLLS
TRNNESSEE-MISSOURI BRIDGE COMMISSION.
#70-03752 06P.

TOXICITY

RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL

DISPERSING PRODUCTS,

#70-03913

PIOSTIMULATION AND TOXICITY CRITERIA AND APPLICATIONS IN DESIGN--PRESENT PRACTICE AND FUTURE POSSIBILITIES, W70-03982

TRACE ELEMENTS

TRACE ELEMENT MEASUREMENTS IN THE AQUATIC ENVIRONHENT, W70-03981

TRACERS
DOWNWARD MOVEMENT OF SOIL MOISTURE TRACED BY MEANS OF MYDROGEN ISOTOPES, W70-03689 02G

THE APPLICATION OF ISOTOPES TO SOME PROBLEMS IN ATMOSPHERIC SCIENCES, W70-03690 02B

THE ATMOSPHERIC TRANSPORT OF TRITIUM, W70-03692 02B

APPLICATION OF DEUTERIUB ANALYSES TO THE HYDROLOGY OF THE LAKES OF THE GRAND COULEE, WASHINGTON, W70-03696 02K

ULTRA-LOW VELOCITY MEASUREMENT IN A STRATIFIED RESERVOIR BY ISOTOPIC CURRENT METER, W70-03697 02H

RADIOCARBON DETERMINATIONS APPLIED TO GROUNDWATER HYDROLOGY, W70-03890 02F

GROUNDWATER FLOW AND DIRECTION MEASUREMENT BY MEANS OF RADIOISOTOPES IN A SINGLE WELL, W70-03892 02F

USE OF CHEMICAL AND RADIOACTIVE TRACERS AT THE NATIONAL REACTOR TESTING STATION, IDARO, W70-03893

LARGE-SCALE UTILIZATION OF TRITIUM IN HYDROLOGIC STUDIES, W70-03894 02A

TECHNIQUES OF GROUNDWATER TRACING USING RADIONUCLIDES, W70-03896 02F

FRACTIONATION OF TRITIUM AND DEUTERIUM IN SOIL WATER, 970-03897

ENVIRONMENTAL TRITIUM STUDIES AT THE BATIONAL REACTOR TESTING STATION, #70-03898 05B

THE USE OF A TRACER TEST TO VERIFY AN ESTIMATE OF THE GROUNDWATER VELOCITY IN PRACTURED CHYSTALLINE ROCK AT THE SAVANNAH RIVER PLANT NEAR AIKEN, SOUTH CAROLINA, W70-03899

WATER TRACING IN THE HYDROLOGIC CYCLE, W70-03900 02A

A BREAKTHROUGH IN THE TRACER STUDIES OF SEDIMENTATION TANKS, W70-03922 05D

TRACKING TECHNIQUES
RADIOCARBON DETERMINATIONS APPLIED TO GROUNDWATER HYDROLOGY, W70-03890 02F

DEVELOPMENT OF ISOTOPE METHODS APPLIED TO GROUNDWATER HYDROLOGY, $\mathbf{W70-03891}$

USE OF CHEHICAL AND RADIOACTIVE TRACERS AT THE MATIONAL REACTOR TESTING STATION, IDAHO, W70-03893 02F

W70-03893 02F

TRADE
AN EXAMINATION OF LIMEAR HOMOGENEITY OF TRADE AND PRODUCTION FUNCTIONS IN COUNTY LEONTIEF HATRICES, 970-03824 06A

TRANSPORTATION
REGULATION OF FERRY OPERATIONS.
W70-03739 06

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES SUMMARY REPORT, W70-04008 05E

TREATMENT
BIODEGRADABILITY AND TREATABILITY OF COMBINED NYLOW AND MUNICIPAL WASTES, U70-03926
05D

TRICKLYNG PILTERS
DIPLOGASTERID AND RHABDITID HEMATODES IN A WASTEWATER
TREATMENT PLANT,
W70-03925
05D

TRICKLING FILTER HODEL DESIGN AND COST FACTORS, W70-03947

TRITIUM
THE ATHOSPHERIC TRANSPORT OF TRITIUM,
W70-03692 02B

CONTRIBUTION OF ISOTOPE TECHNIQUES TO THE STUDY OF SOME HYDROLOGICAL PROBLEMS, W70-03694 028

THE USE OF RADIOACTIVE TRACER GASES TO STUDY THE RATE OF EXCHANGE OF WATER VAPOR BETWEEN AIR AND WATURAL SUPPACES, W70-03695

USE OF CHEMICAL AND RADIOACTIVE TRACERS AT THE NATIONAL REACTOR TESTING STATION, IDANO, W70-03893 02F

LARGE-SCALE UTTLIZATION OF TRITIUM IN HYDROLOGIC STUDIES, FRACTIONATION OF TRITIUM AND DEUTERIUM IN SOIL WATER, ENVIRONMENTAL TRITIUM STUDIES AT THE NATIONAL REACTOR TRITIUM CIRCULATION
THE ATMOSPHERIC TRANSPORT OF TRITIUM,
W70-03692
028 TRITIUM CONTAMINATION
ENVIRONMENTAL TRITIUM STUDIES AT THE NATIONAL REACTOR
TESTING STATION,
W70-03898
058 TRITIUM PRACTIONATION
PRACTIONATION OF TRITIUM AND DEUTERIUM IN SOIL WATER, \$70-03497
02G TROPHIC BIOLOGY CONCEPTS OF RUTROPHICATION AND TROPHIC BIOLOGY, W70-03959 02H TUBE-CLARIFIER SYSTEM
TUBE CLARIFICATION PROCESS, OPERATING EXPERIENCES,
#70-03911
05D TUNNEL CONSTRUCTION
TUNNELLING METHODS IN HUNGARY,
#70-03790 TUNNELING
TUNNELLING METFODS IN HUNGARY,
W70-03790 TUNNELING MACHINES
ROCK CUTTING RESEARCH FOR THE DESIGN AND OPERATION OF
TUNNELING MACHINES, TUNNELS
THE PROBLEMS ON TUNNEL EXPLORATION,
#70-03792 TURBULFNCF
DIFFUSION AND ENTRAINMENT IN TWO-LAYER PLOW,
W70-03728
088 **SALT-BISCUITS' - A SPECIAL GROWTH STRUCTURE OF NACL IN SALT SPIMENTS OF THE TUZ GOLU ('SALT LAKE'), TURKEY, W70-03671 UNCERTAINTY
ON INDEPENDENCE POSTULATES CONCERNING CHOICE,
#70-03832 UNIFORMITY CORFFICIENT
AN EVALUATION OF THREE CORFFICIENTS AS A MEASURE OF UNIFORMITY OF WATER APPLICATION BY SPRINKLERS, W70-03803 03F UNIT HYDROGRAPHS
A PRINCIPAL COMPONENT ANALYSIS OF SURFACE RUNOFF DATA FROM A NEW ZEALAND ALFINE WATERSHED,
W70-03908
02E UNSATURATED FLOW
NUMBERCAL METHOD FOR ESTIMATING SIMULATANEOUS FLOW OF WATER
AND SALT IN UNSATURATED SOILS,
#70-03851
02G EVALUATION OF FLOW PARAMETERS, W70-03880 MECHANICS OF THE MOVEMENT OF HOISTURE AND CHEMICAL SUBSTANCES IN SOILS, W70-03981 SIMILITUDE FOR PARTIALLY SATURATED FLOW SYSTEMS, W70-03883 UPTAKE
UPTAKE OF GLYCINE BY BLUE-GREEN ALGAE,
W70-03958
05C C-14 OPTAKE AS A SENSITIVE MEASURE OF THE GROWTH OF ALGAL REDUCTION OF ANNUAL RIVER FLOWS TO LONGER PERIODS (RUSSIAN), W70-03661 CALCULATION OF MAXIMUM DISCHARGES OF CRIMEAN RIVERS RUNOFF VOLUME AND HAXIBUM DISCHARGES OF SPRING FLOODS APPLIED TO THE UNSTUDIED RIVERS OF KALININGRADSK REGION (RUSSIAN), #70-03683 02E METHODS FOR THE DETERMINATION OF MAXIMUM SNOW RESERVES IN THE RIVER BASINS OF THE CENTRAL CHERNOZEM (BLACK FARTH) BELT (RUSSIAN),

02C W70-03684 MINERAL RIGHTS VERSUS WATER RIGHTS, W70-03735 HYDROLOGIC RECONNAISSANCE OF SKULL VALLEY, TOOLLE COUNTY, W70-03811 FACTORS INFLUENCING ALGAL PRODUCTIVITY IN DEER CREEK RESERVOIR, UTAH, W70-03986 02R UTILITY FUNCTION
ON INDEPENDENCE POSTULATES CONCERNING CHOICE,
W70-03832
06B WATER-HAMMER ATTENUATION WITH A TAPERED LINE, W70-03785 VARIABILITY
A BETHOD FOR STATISTICAL EVALUATION OF WEATHER MODIFICATION
AT THE RIVER FLOW CONTROL LEVEL,
W70-03848
03B VEGETATION EFFECTS
SOME EFFECTS OF SHADE COVER ON STREAM TEMPERATURE IN
SOUTHEAST ALASKA,
OSG INFILTRATION RATES AS AFFECTED BY DESERT VEGETATION, W70-03864 VENEZUELA

RADIOCARBON AGES OF GROUNDWATER IN AN ARID ZONE UNCONFINED ERTICAL TUBE EVAPORATOR DESALTING PLANT
DEVELOPMENT OF MATHEMATICAL MODEL AND COMPUTER PROGRAM FOR
OPTIMIZATION OF VERTICAL TUBE EVAPORATOR SALINE WATER ¥70-03665 VES PRODUCTION FUNCTION
A GENERALIZATION OF THE CES PRODUCTION FUNCTION,
W70-03829 06A VIETNAM REPORT OF AN ALGAL BLOOM IN VIET-NAM, W70-03969 05C PERMENTATION OF SPENT SULPITE LIQUOR FOR THE PRODUCTION OF VOLATILE ACIDS, W70-03921 WASTE ASSIMILATIVE CAPACITY
USES OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL
STUDIES CHAPTER IV,
W70-03934
05B WASTE DISPOSAL SEWER DISTRICTS. W70-03737 05G POWERS UNDER CITY MANAGER CHARTER. W70-03749 06 E MANAGEMENT OF INDUSTRIAL EFFLUENT DISPOSAL IN BRITAIN, W70-03877 BIODEGRADABILITY AND TREATABILITY OF COMBINED NYLON AND MUNICIPAL WASTES, W70-03926 05D ECONOMIC ANALYSIS IN WATER QUALITY MANAGEMENT, W70-04000 06B BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES SUMMARY REPORT, W70-04004 05E BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES VOLUME I - THE WASTE MANAGEMENT CONCEPT. W70-04005 BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES WOLUNE II - CRITERIA FOR WASTE HANAGEMENT, W70-04006 05E WASTE TREATMENT WASTEWATER RATES AND SERVICE CHARGES IN GREAT BRITAIN, W70-03875 06P. PHYSICOCHEMICAL TREATMENT OF WASTEWATER, 05D WASTEWATER
DIPLOGASTERID AND RHABDITID NEMATODES IN A WASTEWATER
TREATHENT PLANT,
W70-03925
05D WASTEWATER TREATMENT
BIODEGRADABILITY AND TREATABILITY OF COMBINED NYLON AND
MUNICIPAL WASTES,
W70-03926
05D

THE ECONOMICS OF AGRICULTURAL WATER USE, W70-03998 06B WATER ALLOCATION (POLICY)
WATER DEVELOPMENT FUND. W70-03770 WATER ADMINISTRATION - A SUGGESTED INSTITUTIONAL MODEL, W70-04010 06E 06E #70-04011 068 W70-04012 WATER ANALYSIS
COMPARISON STUDIES OF WINKLER VS. OXYGEN SENSOR, ¥70-03876 WATER AND LAND RESOURCES ADMINISTRATIVE ARRANGEMENTS POR WATER RESOURCES DEVELOPMENT IN HONDANA, W70-04044 TEM CHEMISTRY - A SPECTAL GROWTH STRUCTURE OF NACL IN SALT SEDIMENTS OF THE TUZ GOLU ('SALT LAKE'), TURKEY, W70-03671 THERMO-OSMOSTS THROUGH COMPACTED SATURATED CLAY MEMBRANES, REGIONAL VARIATIONS OF RIVER WATER COMPOSITION RESULTING FROM HALITE SCLUTION, MACKENZIE RIVER DRAINAGE BASIN, DIEL AND SEASONAL VARIATIONS IN PHYSIOCHEMICAL LIMNOLOGY, SPEED RIVER, ONTARTO, W70-03861 A WORKING MODEL FOR THE VARIATION IN STREAM WATER CHEMISTRY AT THE HUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE, WYTO-03867, 02K WATER CONSERVATION
WATER CONSERVANCY DISTRICTS.
W70-04029 030 N70-04030 030 870-04031 06 E MISSOURT SOIL AND WATER CONSERVATION DISTRICTS LAW. #70-04041 WATER COST
OPERATION OF SPA WATER DISTILLATION PLANTS, WATER DEMAND THE WATER SUPPLY SYSTEM UP TO A.D. 2001, W70-03842 STRATEGY FOR MICHIGAN WATER RESOURCES MANAGEMENT APPROACH, W70-03944 06B A SYSTEMS WATER DESALTING
ON SUBSIDIES TO SPEED THE RATE AT WHICH TECHNOLOGIES ARE DEVELOPD,
W70-03930
068 WATER DISTRICTS
WATER SUPPLY DISTRICTS.
W70-04022 WATER CONSERVANCY DISTRICTS. W70-04029 03D M70-04030 W70-04031 MISSOURI SOTE AND WATER CONSERVATION DISTRICTS TAW. W70-04041 WATER HAMMER ATTENUATION WITH A TAPERED LINE, W70-03795 WATER HAPPESTING
LABORATORY TESTS OF SPRAYABLE MATERIALS FOR RUNOPP
TNDUCEMENT ON A LORSSIAL SOIL, RUNOFF INDUCEMENT IN ARID LANDS, W70-03809 WATER LAW

INSTITUTIONAL PACTORS APPECTING LAND AND WATER DEVELOPMENT,
LOWER PIO GRANDE VALLEY, TEXAS,
W70-03865

06B FLORIDA'S LAKES (PROBLEMS IN A WATER PARADISE), 970-04013 WATER LEVEL PLUCTUATIONS

UPCONTING OF PRESH WATER-SEA WATER INTERPACE BELOW PUMPING WELLS, FIELD STUDY,

W70-03677

A TEN-UNIT WATER LEVEL SENSING AND RECORDING SYSTEM, W70-03857 WATER LEVELS
A TEN-UNIT WATER LEVEL SENSING AND RECORDING SYSTEM,
W70-03857
07B WATER MANAGEMENT (APPLIED)
ON THE FLUCTUATION OF WATER RESOURCES,
W70-03705
02A STOCHASTIC ASPECTS OF RESERVOIR STORAGE, W70-03706 02A MINERAL RIGHTS VERSUS WATER RIGHTS, W70-03735 06E WATER DEVELOPMENT FUND. W70-03770 MANAGEMENT OF INDUSTRIAL EFFLUENT DISPOSAL IN BRITAIN, W70-03877 EVALUATION OF EXCEEDANCE PROBABILITY OF FLOOD FOR FLOOD-PROTECTION WORKS IN RIVER, W70-03886 04A WATERSHED DISTRICTS. W70-03917 04D THE USE OF REMOTE SENSING IN WATER RESOURCE HANAGEMENT, W70-03985 WATER SUPPLY DISTRICTS. W70-04022 WATER MEASUREMENT
AN EVALUATION OF THREE COEFFICIENTS AS A MEASURE OF
UNIFORMITY OF WATER APPLICATION BY SPRINKLERS, WATER POLLUTION
DIPPUSION AND ENTRAINMENT IN TWO-LAYER PLOW,
W70-03728
08B CONSERVING RESOURCES AND HAINTAINING A QUALITY ENVIRONMENT, NITRATE CONTENT OF THE UPPER BIO GRANDE AS INPLUENCED BY NITROGEN FEBRULIZATION OF ADJACENT IRRIGATED LANDS, W70-0389 058 THE FUTURE OF THE NORTH CAROLINA COASTAL AREA. W70-04032 WATER POLLUTION CONTROL PRIVATE SEWER SYSTEMS. ¥70-03736 USES OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES CHAPTER IV, W70-03934 05B RUTROPHICATION CAUSES, CONSEQUENCES, CORRECTIVES. W70-03975 SEWERAGE - WATER WORKS. W70-04025 WATER POLLUTION EPPECTS
A DISCUSSION OF NATURAL AND ABNORMAL DIATOR COMMUNITIES,
05C THE RESPONSE OF NATURAL MICROBIAL POPULATIONS IN STANATER TO ORGANIC ENRICHMENT, W70-03967 ONONDAGA LAKE, NEW YORK--AN UNUSUAL ALGAL ENVIRONMENT, W70-03974 OSC EUTROPHICATION CAUSES, CONSEQUENCES, CORRECTIVES. W70-03975 FISH AND GAME (THE WILDLIFE AND FORESTRY LAW). W70-04026 WATER POLIUTION SOURCES
STATISTICAL EVALUATION OF SALINITY AND NITHATE CONTENT AND
TREMDS BENEATH URBAN AND AGRICULTURAL AREA-FRESHO,
CALIFORNIA, W70-03649 EUTROPHICATION CAUSES, CONSEQUENCES, CORRECTIVES. W70-03975 WATER PURIFICATION
THE WATER-RESOURCE COMMUNICATIONS GAP,
W70-03841
06D WATER QUALITY
USER TRIALS OF A SUBMERSIBLE WATER QUALITY RECORDING METER,
W70-03662
05A COMMUNITIES OF OVER 1,000 POPULATION WITH WATER CONTAINING IN EXCESS OF 1,000 PPM OF TOTAL DISSOLVED SOLIDS, W70-03664 07C HYDROLOGIC RECONNAISSANCE OF SKULL VALLEY, TOOBLE COUNTY, UTAH. W70-03811

SUBJECT INDEX

A RATTERY POWERED PROPORTIONAL STREAM WATER SAMPLER, W70-03856 07B REGIONAL VARIATIONS OF RIVER WATER COMPOSITION RESULTING PROM HALITE SOLUTION, MACKENZIE RIVER DRAINAGE BASIN, CANADA DIEL AND SEASONAL VARIATIONS IN PHYSIOCHEMICAL LIMNOLOGY, SPEED RIVPR, ONTARIO, A WORKING MODEL FOR THE VARIATION IN STREAM WATER CHEMISTRY AT THE HUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE, W70-03867 AVAILABILITY OF GROUNDWATER IN WAYNE COUNTY, IOWA, W70-03879 RECLAIMED WASTPWATER FOR SANTEE RECREATIONAL LAKES, RIOSTIMULATION AND TOXICITY CRITERIA AND APPLICATIONS IN DESIGN--PRESENT PRACTICE AND FUTURE POSSIBILITIES, W70-0.3982WATER RESOURCES MANAGEMENT AND PUBLIC POLICY. N70-03995 WATER QUALITY CONTROL
USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES
CHAPTER ITI,
W70-03933
05B EXAMINATION INTO THE REPECTIVENESS OF THE CONSTRUCTION GRANT PROGRAM FOR ABATING, CONTROLLING AND PREVENTING WATER WATER QUALITY CRITERIA
BIOSTIMULATION AND TOXICITY CRITERIA AND APPLICATIONS IN
DESIGN--PRESENT PRACTICE AND FUTURE POSSIBILITIES,
06P WATER RESIDUALS
PRODUCTION, CONSUMPTION, AND EXTERNALITIES,
W70-03843
06B WATER RESOURCE DEVELOPMENT CONSERVING RESOURCES AND MAINTAINING A QUALITY ENVIRONMENT, W70-03823 THE DYNAMIC PROGRAMMING APPROACH TO WATER-RESOURCES DRVRLOPMENT, W70-03836 06B WATER RESOURCES MANAGEMENT AND PUBLIC POLICY. WATER FOR WESTFRN FEDERAL IRRIGATION PROJECTS, W70-03996 03P WATER RESOURCE DEVELOPMENT IN CALIFORNIA THE COMPARATIVE EFFICIENCY OF LOCAL, STATE AND FEDERAL AGENCIES, W70-0397 044 BENEFIT-COST ANALYSTS A CRITERION FOR SOCIAL INVESTMENT, #70-03999 06B BIBLIOGRAPHY OF THE GROUNDWATER RESOURCES OF NEW YORK THROUGH 1967, GEOLOGY AND GROUNDWATER RESOURCES OF OCEAN COUNTY, NEW JERSFY, W70-03670 COLOR PHOTOGRAPHS FOR WATER RESOURCES STUDIES, W70-03680 07B BIBLIOGRAPHY ON SOCIO-ECONOMIC ASPECTS OF WATER RESOURCES, W70-03714 06B APPLICATIONS OF COLOR AERIAL PHOTOGRAPHY TO WATER RESOURCES STUDIES, 970-03869 07B AVAILABILITY OF GROUNDWATER IN WAYNE COUNTY, IOWA, W70-03879 02F THE USE OF REMOTE SENSING IN WATER BESOURCE MANAGEMENT, W70-03985 WATER RESOURCES BOARD. W70-04028 WATER RESOURCES DEVELOPMENT
RELATIVE IMPORTANCE OF VARIABLES IN WATER RESOURCES
PLANNING,
W70-03656 06B PUBLIC PARKS, FORESTS AND RECREATION. W70-03746 03D WATER DEVELOPMENT FUND. W70-03770 MISSOURT FEDFRAL WATER PROJECTS RECREATION FUND. W70-03771

INSTITUTIONAL FACTORS AFFECTING LAND AND WATER DEVELOPMENT, LOWER RIO GRANDE VALLEY, TEXAS, W70-03865 06B COST, PRECISION, AND VALUE RELATIONSHIPS OF DATA COLLECTION AND DESIGN ACTIVITIES IN WATER DEVELOPMENT PLANNING, \$470-0398 048 STRATEGY FOR MICHIGAN WATER RESOURCES MANAGEMENT A SYSTEMS APPROACH, W70-03944 06B WATER ADMINISTRATION - A SUGGESTED INSTITUTIONAL MODEL, W70-04010 068 06E WATER RESOURCES BOARD. W70-04028 06E WATER CONSERVANCY DISTRICTS. W70-04029 03D W70-04030 NATIONAL RIVERS AND HARBORS CONGRESS SUPPORTS A COMPREHENSIVE WATER RESOURCES DEVELOPMENT PROGRAM, WATER REUSE
PHYSICOCHEMICAL TREATMENT OF WASTEWATER,
W70-03927
05D WATER RIGHTS
INSTITUTIONAL FACTORS AFFECTING LAND AND WATER DEVELOPMENT,
LOWER RIO GRANDE VALLEY, TEXAS,
W70-03865
06B TER SOPTENING
DESIGN AND COST OF ION-EXCHANGE SOPTENING FOR A 50-HGD SEAWATER EVAPORATION PLANT,
W70-03945
03A WATER SOURCES
PUBLIC HEALTH (MUNICIPAL WATER SUPPLY).
W70-04036 03D WATER SPORTS
TOWN OF PALM BEACH V CARTER (PROHIBITION OF SURFING WITHIN TOWN LIMITS POUND CONSTITUTIONAL).

06E WATER STRUCTURE FORMATION AND GEOLOGICAL ROLE OF GROUNDWATERS, W70-03679 02F WATER SUPPLY
COMMUNITIES OF OVER 1,000 POPULATION WITH WATER CONTAINING
IN EXCESS OF 1,000 PPM OF TOTAL DISSOLVED SOLIDS,
W70-03664
07C RESEARCH AND DEVELOPMENT ON LOW PRESSURE REVERSE OSMOSIS MEMBERANES AND DESIGN OF A SHALL UNIT FOR BRACKISH WATER, W70-03667 HEALTH AND SAPETY (PUBLIC WATER SUPPLY AND SEWER SYSTEM). THE WATER SUPPLY SYSTEM UP TO A.D. 2001, W70-03842 WATER FOR WESTERN FEDERAL IRRIGATION PROJECTS, W70-03996 WATER SUPPLY DISTRICTS. W70-04022 06E PUBLIC HEALTH (MUNICIPAL WATER SUPPLY). 03D WATER SYSTEMS SEWERS AND WATERWORKS. W70-03748 05G WATER TEMPERATURE SOME EFFECTS OF SHADE COVER ON STREAM TEMPERATURE IN SOUTHEAST ALASKA, W70-03819 WATER TRACING
WATER TRACING IN THE HYDROLOGIC CYCLE,
W70-03900
02A WATER TRANSFER INFILTRATION, REDISTRIBUTION, AND SUBSECUENT EVAPORATION OF WATER FROM SOIL AS AFFECTED BY WETTING RATE AND HYSTERESIS, 02G WATER VAPOR
DIFFUSIOPHORETIC AND THERMOPHORETIC EFFECTS ON PARTICULATE MATTER NEAR CONDENSING AND EVAPORATING WATER SURFACES, W70-03691

THE USE OF RADIOACTIVE TRACER GASES TO STUDY THE RATE OF EXCHANGE OF WATER VAPOR BETWEEN AIR AND NATURAL SURFACES, W70-03695

VAPOR LOSSES THROUGH SOIL MULCH AT DIFFERENT WIND VELOCITIES,

WAT-YFA W70-03808 WATER VAPOR DIFFUSION
DIFFUSIOPHORPTIC AND THERMOPHORETIC EFFECTS ON PARTICULATE
MATTER NEAR CONDENSING AND EVAPORATING WATER SURFACES,
028 WATER WORKS SEWERS AND WATERWORKS. W70-03748 05G HEALTH AND SAFETY (PUBLIC WATER SUPPLY AND SEWER SYSTEM). W70-03780 WATERCORRSES (IEGAL)
FLORIDA'S LAKES (NAVIGABILITY AND PUBLIC RIGHTS),
W70-04014
06E BOUNDARIES BY WATERCOURSES. 0.6E WATERPROOFING
LABORATORY TESTS OF SPRAYABLE MATERIALS FOR RUNOFF
INDUCPMENT ON A LORSSIAL SOIL, WATERSHED MANAGEMENT SEDIMENT TIELDS FROM THE CENTRAL COLORADO SNOW ZONE, #70-01821 WATERSHED DISTRICTS. W70-03917 WATPRSHED PLANNING
THP WATERSHED AS AN ENTITY FOR PLANNING,
W70-03987 068 SECTION I, INTRODUCTION SPCTION II, DETERMINATION OF DESIGN DISCHARGE SPCTION IX, APPENDIX. W70-03815 THP WATERSHED AS AN ENTITY FOR PLANNING W70-03987 COMMENT ON, 'THE WATERSHED AS AN ENTITY FOR PLANNING', W70-03988COMMENT ON, "MESHING WATERSHED DEVELOPMENT WITH RIVER BASIN DEVELOPMENT", WTO-03989 , 06B

WATER-YIPLD IMPROVEMENT SEDIMENT YIPLDS FROM THE CENTRAL COLORADO SNOW ZONE, W70-03821 2J

WAVES (WATER) COMPUTER STUDIES OF FINITE-AMPLITUDE WATER WAVES, W70-04009 07C

WEATHER AND DIURNAL FROZEN SOIL STRUCTURE AT CHARLOTTESVILLE, VIRGINIA, W70-03863 WEATHER MODIFICATION
SHAPING THE LAW OF WEATHER CONTROL,
W70-03719 068 A METHOD FOR STATISTICAL EVALUATION OF WEATHER HODIFICATION AT THE RIVER FLOW CONTROL LEVEL, W70-03848 HELPARE ECONOMICS
PRODUCTION, CONSUMPTION, AND EXTERNALITIES,
W70-03843
06B SPIECTED ANALYTICAL METHODS FOR WELL AND AQUIPER EVALUATION, W70-03943 W70-03943 WETTABILITY
WETTING AGENT TESTS.
W70-03812 WETTING
LIGHT WATPR AND PROTEIN FOAM.
W70-03813 WETTING AGENT TESTS. W70-03812 WILDLIFE CONSERVATION
PISH AND GAME (EMPORCEMENT OF GAME AND PISH LAWS).
W70-03778
06E WIND VELOCITY
VAPOR LOSSES THROUGH SOIL MULCH AT DIFFERENT WIND
VELOCITIES,
02G WISCONSIN

EPPECTS OF PLOOD PROTECTION ON LAND USE IN THE COON CREEK,
WISCORSIN, WATERSHED,
W70-03654

O4A PARTITION WHEN LAND BOUNDED BY WATER. W70-03786 WISCONSIN PLOOD CONTROL AGENCIES. W70-03789 WISCONSIN PLOOD CONTROL. W70-03802 SOIL AND WATER CONSERVATION DISTRICTS. W70-03918 DRAINS, DRAINAGE PROCEEDINGS, AND DRAINAGE DISTRICTS. W70-03920 ECOLOGY OF YEASTS PROH LAKE CHAMPLAIN, W70-03962

AUTHOR INDEX

AALDERS, J. H. M.

MECHANICS OF THE MOVEMENT OF MOISTURE AND CHEMICAL SUBSTANCES IN SOILS,

W70-03881

O2G

ACHARYA, C. L.

VAPOR LOSSES THROUGH SOIL MULCH AT DIFFERENT WIND VELOCITIES,

W70-03808

O2G

ADRIAN, DONALD DRAN
INFILTRATION INDUCED SOIL INSTABILITIES,
W70-03648 02G

AHEARN, D. G.
ECOLOGY OF YEASTS FROM LAKE CHAMPLAIN,
W70-03962 05A

ALLTSON, STEPHEN V.
COST, PRECISION, AND VALUE RELATIONSHIPS OF DATA COLLECTION
AND DESIGN ACTIVITIES IN WATER DEVELOPMENT PLANNING,
W70-03938

AMBERG, H. R.
PERMENTATION OF SPENT SULPITE LIQUOR FOR THE PRODUCTION OF VOLATILE ACIDS, W70-03921

O5D

ANDERSON, HENRY R.
GEOLOGY AND GROUNDWATER RESOURCES OF OCEAN COUNTY, NEW
JERSEY,
W70-03670 02P

ANDERSON, W. D.
FUNCTIONS FOR COTTON (GOSSYPIUM HIRSUTUM L.) PRODUCTION FROM
IRRIGATION AND NTWROGEN PERTILIZATION VARIABLES II. YIELD
COMPONENTS AND QUALITY CHARACTERISTICS,
W70-03805

ANWAR, HABIB O.
BRHAVIOR OF BUOYANT JRT IN CALM FLUID,
W70-03724
088

APPPL, CHARLES A.

GEOLOGY AND GROUNDWATER RESOURCES OF OCEAN COUNTY, NEW
JERSEY,
170-03670

ARMSTRONG, RICHARD
C-14 UPTAKE AS A SENSITIVE MEASURE OF THE GROWTH OF ALGAL
CULTURES,
W70-03983
05C

ASKEW, A. J.
USF OF THE CRITICAL PERIOD IN RESERVOIR ANALYSIS,
W70-03655 04A

ASPITABLE, T. R.

PREMENTATION OF SPENT SULFILE LIQUOR FOR THE PRODUCTION OF VOLATILE ACIDS, #70-03921 05D

ASSUR, A.
PRACTURE OF LAKE AND SEA ICE,
W70-03651

AYRES, R. V.
PRODUCTION, CONSUMPTION, AND EXTERNALITIES,
W70-03843

AZAD, H. S.
A METHOD FOR PREDICTING THE EFFECTS OF LIGHT INTENSITY ON ALGAL GROWTH AND PHOSPHOROUS ASSIRILATION, W70-03923

BACK, WILLIAM RADIOCARBON DETERMINATIONS APPLIED TO GROUNDWATER HYDROLOGY, W70-03890 02F

BAIER, W.
RELATIONSHIPS RETWEEN SOIL HOISTURE ACTUAL AND POTENTIAL
EVAPOTRANSPIRATION,
W70-03885
02D

BAIN, JOE S.
WATER RESOURCE DEVELOPMENT IN CALIFORNIA THE COMPARATIVE EPPICIENCY OF LOCAL, STATE AND FEDERAL AGENCIES, W70-03997 04A

BAKELS, C. C. AVAILABILITY OF MUD PHOSPHATES FOR THE GROWTH OF ALGAE, W70-03955 05C

BALL, V.
SHAPING THE LAW OF WEATHER CONTROL,
W70-03719
06E

PANKER, R. F.
COMMUNITIES OF OVER 1,000 POPULATION WITH WATER CONTAINING
IN EXCESS OF 1,000 PPM OF TOTAL DISSOLVED SOLIDS,
W70-03664 07C

BARRY, P. J.
THE USE OF RADIOACTIVE TRACER GASES TO STUDY THE RATE OF EXCHANGE OF WATER WAPOR BETWEEN AIR AND NATURAL SURFACES, #70-03695 02C

BASSETT, LOWELL
RETURNS TO SCALE AND COST CURVES,
W70-03844 06C

BAZER, G. T.
DIPLOGASTERID AND RHABDITID NEMATODES IN A WASTEWATER
TREATMENT PLANT,
W70-03925
05D

BENFORD, HARRY
INVESTMENT RETURNS BEFORE AND AFTER TAX,
W70-03827 06B

BERNIER, J.
THE BAYES METHODS OF STATISTICAL HYDROLOGY (FRENCH),
W70-03906
02a

BHAGAT, SURINDER K.
TRACE ELEMENT HEASUREMENTS IN THE AQUATIC ENVIRONMENT, W70-03981

BIERLY, EUGENE W.

THE APPLICATION OF ISOTOPES TO SOME PROBLEMS IN ATMOSPHERIC SCIENCES, W70-03690

02B

BISHOP, A. W.
PORE PRESSURE MEASUREMENTS IN THE FIELD AND IN THE
LABORATORY, PART I AND PART II,
W70-03797 ORD

BLANDFORD, ROBERT
NOTES ON THE THEORY OF THE THERMOCLINE,
W70-03726 02L

BLENCH, T.

MOBILE-BED FLUVIOLOGY,
W70-03669 02

BLOOM, R., JR.
PRYSICOCHEMICAL TREATMENT OF WASTEWATER,
W70-03927 05D

BORCHARDT, J. A.
A METHOD FOR PREDICTING THE EFFECTS OF LIGHT INTENSITY ON
ALGAL GROWTH AND PHOSPHOROUS ASSIMILATION,
W70-03923
OSC

DIALYSIS SEPARATION OF SEWAGE SLUDGE DIGESTION, W70-03929 05D

BORMANN, F. H.
A WORKING MODEL FOR THE VARIATION IN STREAM WATER CHEMISTRY
AT THE HUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE,
W70-03867

BOWER, B. T.
RELATIVE IMPORTANCE OF VARIABLES IN WATER RESOURCES
PLANNING,
W70-03656 06B

BOWER, C. A. ROOTZONE SALT PROFILES AND ALFALFA GROWTH AS INFLUENCED BY IRRIGATION WATER SALINITY AND LEACHING FRACTION, 470-03807.

NITRATE CONTENT OF THE UPPER RIO GRANDE AS INFLUENCED BY NITROGEN FERTILIZATION OF ADJACENT IRRIGATED LANDS, W70-03849

BOZINOVIC, MIODRAG STATISTICAL CONSIDERATION IN RIVER MORPHOLOGY, W70-03708 02E

BRESLER, E. NUMERICAL METHOD FOR ESTIMATING SIMULATANEOUS FLOW OF WATER AND SALT IN UNSATURATED SOILS, \$170-03851 02G

INFILTRATION, REDISTRIBUTION, AND SUBSEQUENT EVAPORATION OF WATER FROM SOIL AS AFFECTED BY WETTING RATE AND HYSTERESIS, W70-03852

BREZINA, E. R.
THERMAL DISCHARGE AND WATER QUALITY IN A 1,500-ACRE
RESERVOIR,
W70-03845
05C

BRITT, CLARENCE S.
CONSERVING RESOURCES AND HAINTAINING A QUALITY ENVIRONMENT, W70-03823 05B

BROCK, THOMAS D.

BACTERIAL GROWTH RATE IN THE SEA DIRECT ANALYSIS BY THYHIDINE AUTORADIOGRAPHY,

W70-03968 05C

BROOKS, R. H.
SIMILITUDE FOR PARTIALLY SATURATED FLOW SYSTEMS,

BROWN, GARDNER
THE ECONOMICS OF AGRICULTURAL WATER USE,
W70-03998 06B

BRUK, STEVAN STATISTICAL CONSIDERATION IN RIVER MORPHOLOGY,

BRU-DIL

028

RRUTSAERT, WILFRIED STOCHASTIC ASPECTS OF LAKE ONTARIO EVAPORATION, W70-03872 02D

BURAS, NATHAN
THE DYNAMIC PROGRAMMING APPROACH TO WATER-BESOURCES
DEVELOPMENT,

BURNS, CAROLYN W.
RELATION BETWEEN FILTERING RATE, TEMPERATURE, AND BODY SIZE
IN FOUR SPECIES OF DAPHNIA,
W70-03957
05C

BUTSCH, RICHARD J.
RESERVOIR SYSTEM DESIGN OPTIMIZATION,
W70-03941 044

CAGLE, J. W. AVAILABILITY OF GROUNDWATER IN WAYNE COUNTY, TOWA, W70-03879 02F

CAMPBELL, ROBERT S.
THERMAL DISCHARGE AND WATER QUALITY IN A 1,500-ACRE

CANDELA, BASIL
LARGE VOLUME - LONG DISTANCE FRESH WATER TRANSPERRAL AS AN ALTERNATE TO DESALINATION,
970-03810 06D

CARNEY, J. C.
BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL STIFS SUMMARY REPORT, W70-04004 05E

CARPENTER, WILLIAM L.
TEMPERATURE RELATIONSHIP IN AEROBIC TREATMENT AND DISPOSAL OF PULP AND PAPER WASTPS,
RT0-03720 05D

CABROLL, T. E.
BIBLIOGRAPHY ON SOCTO-RECONDMIC ASPECTS OF WATER RESOURCES,
W70-03714 06B

CARSTENS, T.
DIFFUSION AND ENTRAINMENT IN TWO-LAYER PLOW, W70-03728 08E

CASAGRANDE, L.
ON THE EFFECTIVENESS OF SAND DRAINS,
W70-03784 ORD

CHAN, E. C. S.
DISTRIBUTION, CHARACTERIZATION, AND NUTRITION OF MARINE MICROORGANISMS FROM THE ALGAP POLYSIPHONIA LANGSA AND ASCOPHYLLUM NODOSUM, 170-03952

CHAN, ROBERT K. C.
COMPUTER STUDIES OF FINITE-AMPLITUDE WATER WAVES, #70-04009 07C

CHASE, F. H.
CATALOG OF INFORMATION ON WATER DATA, PDITION 1968 - INDEX
TO GROUNDWATER STATIONS,

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO APPAL INVESTIGATIONS AND MISCELLANEOUS ACTIVITIES, W70-03663

CHENOUARD, LYDIF
GAMBA-RAY SPECTROSCOPY AS A TOOL FOR A RAPID INVESTIGATION
OF DETRITIC CORES,
.0.78

CHESTER, P. THE INTRA-PRO DETERMINATION OF QUARTZ IN SEDIMENTS AND SEDIMENTARY FOCKS, W70-03678

CLINE, J. N.
EVAPORATIVE COOLING OF HEATED IRRIGATION WATER BY SPRINKLER
APPLICATION,
W70-03718
05D

CT.YDE, EDWARD W.
MINPRAL RIGHTS VERSUS WATER RIGHTS,
W70-03735

COCKELL, G. J.

A MOSAIC TRCHNIQUE FOR GENERATING THE DAILY PATTERN WITHIN A SYNTHETIC FLOW SROUPNCE,
W70-03704

02A

COFFFY, C. T.
APPLICATION OF PORE PRESSURE MEASUREMENTS TO SHEAR STRENGTH
OF COMESSIVE SOILS,
W70-03788

COLEMAN, NEIL L.
UNIFICATION OF DATA ON SEDIMENT TRANSPORT IN FLUMES BY
SIMILITUDE PRINCIPLES,
W70-03874
02J

COLE, J. A. A MOSAIC TECHNIQUE FOR GENERATING THE DAILY PATTERN WITHIN A

SYNTHETIC FLOW SEQUENCE,

CONLEY, WALTER R.
TUBE CLARIFICATION PROCESS, OPERATING EXPERIENCES, #70-03911

COOK, W. L.

ECOLOGY OF YEASTS FROM LAKE CHAMPLAIN,

W70-03962

05A

COOPER, LEON
AN EXTENSION OF THE GENERALIZED WEBER PROBLEM,
W70-03840 06A

CORCORAN, E. F.
SURPACE SLICKS AS CONCENTRATORS OF PESTICIDES IN THE MARINE
ENVIRONMENT,

CORRY, A. T. SIBLITUDE FOR PARTIALLY SATURATED FLOW SYSTEMS, W70-03883

COREY, G. L.
SIMILITUDE FOR PARTIALLY SATURATED FLOW SYSTEMS,
W70-03883 02G

CORMACK, J. F.
FERRENTATION OF SPENT SULPITE LIQUOR FOR THE PRODUCTION OF
VOLATILE ACIDS,
W70-03921
05D

CRAINE, LYLE E.

COMMENT ON, "HESHING WATERSHED DEVELOPMENT WITH RIVER BASIN DEVELOPMENT",

CRUTCHFIELD, JAMES A.

ECONOMIC ANALYSIS IN WATER QUALITY MANAGEMENT,

W70-04000 06B

CULP, GORDON L.
TUBE CLARIFICATION PROCESS, OPERATING EXPERIENCES, W70-03911 05D

CURTIS, W. F.

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX
TO AREAL INVESTIGATIONS AND HISCELLANEOUS ACTIVITIES,

02E

CUSENS, A. R.
DISTRIBUTION OF CONCENTRATED LOADS ON ORTHOTROPIC PRIDGE DECKS,
W70-03798
08A

CZEPA, OTTO
ADAPTIVE PILTERS POR TREND EXTRAPOLATION OF RUNOFF RECORDS, W70-03710
07C

DAGON, RONALD

LARCE VOLUME - LONG DISTANCE PRESH WATER TRANSFERRAL AS AN ALTERNATE TO DESALINATION, 06D

DAVIDSON, J. B. FIELD HEADTH AND USE OF SOIL-WATER PROPERTIES, W70-03675 02G

DAVIS, ERNST M.
ANIONIC AND HONIONIC SURPACTANT SORPTION AND DEGRADATION BY
ALGAE CULTURES,
W70-03928
05D

DAY, JOHN C.
AN ACTIVITY AWALYSIS OF NON-STRUCTURAL PLAIN HANAGEMENT
ALTERNATIVES CHAPTER IV,
W70-04003
06F

DEININGER, ROLF A.

ESTIMATION OF THE PARAMETERS OF GUMBEL'S THIRD ASIMPTOTIC
DISTRIBUTION BY DIFFERENT METHODS,

W70-03674

07C

DERR, B. D.
SOIL FACTORS INFLUENCING PERCOLATION TEST PERFORMANCE,
W70-03850
02G

DICKENS, W. L.
FUNCTIONS FOR COTTON (GOSSYPIUM HIRSUTUM L.) PRODUCTION FROM
IRRIGATION ABD WITHOGEN FERTILIZATION VARIABLES II. YIELD
COMPONENTS AND QUALITY CHARACTERISTICS,
P70.02805

FUNCTIONS FOR COTTON (GOSSYPIUM HIRSUTUM L.) PRODUCTION FROM IRRIGATION AND NITROGEN PERTILIZATION VARIABLES I. YIELD AND EVAPOTRANSPIRATION, W70-03806

DICKINSON, W. T.
AN ERROR MODEL FOR A SINGLE DISCHARGE MEASUREMENT,
W70-03700 02E

ERRORS IN DISCHARGE ESTIMATES ON MOUNTAIN STREAMS, W70-03889

DILLON, WILLTAM P.
SUBMERGENCE EFFECTS ON A RHODE ISLAND BARRIER AND LAGOON AND
INFPRENCES ON MIGRATION OF BARRIERS,
W70-03847
02L

DIRKSEN, C. THERMO-OSMOSIS THROUGH COMPACTED		LAY MEMBRANI
₩70-03859	02G	
DOLE, HOLLIS M. OCEAN MINERALS AND THE LAW.		
W70-03822	06E	
DONALDSON, JOHN R.		
THE CLASSIFICATION OF LAKES,	0.24	

DONRY, LLOYD D.

COPING WITH UNCERTAINTY IN THE MAKE OR BUY DECISION, W70-03826

DORCHESTER, J. E. C.
THE EFFECT OF DIETARY PAT ON THE HEAT TOLERANCE OF GOLDFISH (CARASSIUS AURATUS),

02H

DORFMAN, ROBERT
OPERATIONS RESEARCH,
W70-03992

DORRIS, TROY C.

CARBON SOURCES IN ALGAL POPULATIONS AND ALGAL COMMUNITY STRUCTURE,

W70-04001

OSR

DOWNER, RICHARD N.
APPLICATION OF RUNS TO HYDROLOGIC DROUGHTS,
W70-03909 02E

DOYEL, W. W.
CATALOG OP INFORMATION ON WATER DATA, EDITION 1968 - INDEX
TO GROUNDWATER STATIONS,
02F

CATALOG OF INPORMATION ON WATER DATA, EDITION 1968 - INDEX TO AREAL INVESTIGATIONS AND MISCELLANGOUS ACTIVITIES, $\psi 70$ 0-3663

DREIPR, A. P. YIELD-PROTEIN RELATIONSHIPS IN WHEAT GRAIN, AS AFFECTED BY MITROGEN AND WATER,

DUCKSTRIN, LUCIFN
POINT RAINFALL FREQUENCIES IN CONVECTIVE STORMS,
W70-03673
02B

DUGDALP, RICHARD C.

NTTROGEN METABOLISM IN LAKES. I. MEASUREMENT OF NITROGEN
FIXATION WITH N-15, W70-03970

DUGDALE, VERA A.

NITROGEN METABOLISM IN LAKES. I. MEASUREMENT OF NITROGEN
PIXATION WITH N-15,
W70-03970 . 02H

DUKLER, A. E.

DEVELOPMENT OF MATHEMATICAL MODEL AND COMPUTER PROGRAM FOR OPTIMIZATION OF VERTICAL TURE EVAPORATOR SALINE WATER

DUBYEA, R. D.
BIRLINGRAPHY OF THE GROUNDWATER RESOURCES OF NEW YORK
THROUGH 1967,
W70-03659
02F

DYCK, SIEGFRIRD
APPLICATIONS OF MONTE CARLO METHOD TO RESERVOIR DESIGN,
02A

PAGLESON, P. S.
A MODEL FOR GENERATING SYNTHETIC SEQUENCES OF SHORT-TIME-INTERVAL RAINFALL DEPTHS, W70-03703
02B

EDMUNDSON, ELDON, JR.
MARINE RADIOECOLOGY,
W70-03956

RISELSTEIN, LEC H.
A PRINCIPAL COMPONENT ANALYSIS OF SURPACE RUNOPP DATA PROM A
NEW ZEALAND ALPINE WATERSHED,
W70-03998
02E

PLDER, REX A.

ULTRA-LOW VPLOCITY MEASUREMENT IN A STRATIFIED RESERVOIR BY ISOTOPIC CURRENT METER,

W70-03697

02H

ELPICK, D. E.

MECHANICS OF THE MOVEMENT OF MOISTURE AND CHEMICAL
SUBSTANCES IN SOTLS,

W70-03881 02G

PROCARNACION, JOSE
ON INDEPENDENCE POSTULATES CONCERNING CHOICE,
W70-03832
06B

BBIKSSON, BRIK
THE ATMOSPHERIC TRANSPORT OF TRITIUM,
W70-03692
02B

LARGE-SCALE UTILIZATION OF TRITIUM IN HYDROLOGIC STUDIES, W70-03894 02A

EVANS, ROBERT B.
THERMO-ECONOMICS OF SALINE WATER CONVERSION, H70-03935 03A

EVANS, ROBERT H.

OPERATION OF SEA WATER DISTILLATION PLANTS, W70-03657

03A

FERBER, ROBERT
RESEARCH ON HOUSEHOLD BEHAVIOR,
W70-03994 06 B

PILBY, ROYSTON H.
TRACE ELEMENT MEASUREMENTS IN THE AQUATIC ENVIRONMENT,
02H

PISHER, D. W.
A WORKING MODEL FOR THE VARIATION IN STREAM WATER CHEMISTRY
AT THE HUBBARD BROOK EXPERIMENTAL POREST, NEW HAMPSHIRE,
02K

FLETCHER, LEHMAN B.
A GENERALIZATION OF THE CES PRODUCTION FUNCTION,
W70-03829
06A

POGEL, MARTIN M.
POINT RAINFALL FREQUENCIES IN CONVECTIVE STORMS,
W70-03673 02B

FOSS, B. A COST MODEL FOR COASTAL SHIPPING, A NORWEGIAN EXAMPLE, W70-03834 068

FOSTER, WILLIAM S.
THE WATER-RESOURCE COMMUNICATIONS GAP,
W70-03841 06D

FOYN, ERNST REMOVAL OF SEWAGE NUTRIENTS BY ELECTROLYTIC TREATMENT, W70-03972 05D

PREDRIKSEN, R. L. A BATTERY POWERED PROPORTIONAL STREAM WATER SAMPLER, W70-03856 07B

FREY, DAVID G.
EVIDENCE FOR EUTROPHICATION FROM REMAINS OF ORGANISMS IN SEDIMENTS,
W70-03977
02H

PRIEDMAN, IRVING
APPLICATION OF DEUTERIUM ANALYSES TO THE HYDROLOGY OF THE
LAKES OF THE GRAND COULEE, WASHINGTON,
W70-03696
02R

FRY, F. E. J. THE RELATION OF TEMPERATURE TO OXYGEN CONSUMPTION IN THE

SOME POSSIBLE PHYSIOLOGICAL STRESSES INDUCED BY EUTROPHICATION, W70-03976 05C

PUNK, WILLIAM H. TRACE ELEMENT MEASUREMENTS IN THE AQUATIC ENVIRONMENT, W70-03981 02H

GAHLER, ARNOLD R.
SEDIMENT-WATER NUTRIENT INTERCHANGE,
W70-03980

GARDNER, ROBIN P.
HINIMIZING NUCLEAR SOIL DENSITY AND HOISTURE CONTENT GAGE

GAUFIN, ARDEN R.
PACTORS INFLUENCING ALGAL PRODUCTIVITY IN DEER CREEK RESERVOIR, UTAH, W70-03986 02H

GAVER, DONALD P.
DETERMINATION OF OPTIMAL FLOOD PROTECTION LEVELS WITH SMALL EXCEEDANCE PROBABILITIES, W70-03653 06A

GPLLER, I. T.

THE ROLE OF PHOSPHATE-SOLUBLE BACTERIA IN THE ASSIMILATION OF ROCK PHOSPHATE PHOSPHORUS UNDER CONDITIONS OF MONOBACTERIAL CULTURE (IN RUSSIAN),

05C

GELLMAN, ISAIAH
TEMPERATURE RELATIONSHIP IN AEROBIC TREATMENT AND DISPOSAL
OF PULP AND PAPER WASTES,
W70-03720
05D

GIBBS, H. J.
APPLICATION OF PORE PRESSURE MEASUREMENTS TO SHEAR STRENGTH
OF COHESIVE SOILS,
07B

GYLMOUR, B. A.
BIBLIOGRAPHY ON SOCIO-ECONOMIC ASPECTS OF WATER RESOURCES,
W70-03714 06B

GLENN, A. B.
BIBLIOGRAPHY ON SOCIO-ECONOMIC ASPECTS OF WATER RESOURCES,
W70-03714
06B

06B

GLOTMA, EARNEST F.

ANIONIC AND NONIONIC SURFACTANT SORPTION AND DEGRADATION BY
ALGAE COLTUPES;

GOMLL, A.
DISTRIBUTION OF CHLORIDES IN AN IRRIGATED CITRUS ORCHARD,

GOERING, JOHN J.

MITROGEN METAPOLISM IN LAKES. I. MEASUREMENT OF NITROGEN FIXATION WITH N-15,

O2H

GOLDMAN, CHARLES R. C-14 UPTAKE AS A SENSITIVE MEASURE OF THE GROWTH OF ALGAL

GOLDSMITH, PHILLIP
DIFFUSIOPHORETIC AND THERMOPHORETIC EFFECTS ON PARTICULATE
MATTER NEAR CONDENSING AND EVAPORATING WATER SURFACES,
02B

GOLTERMAN, H. L.
AVAILABILITY OF MUD PHOSPHATES FOR THE GROWTH OF ALGAE,
W70-03955
05C

GOODMAN, ALVIN
USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES
CHAPTER III,
W70-03933
058

USRS OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES CHAPTER IV, W70-03934 05B

GORDON, JEROME B.
SOCIOECONOMIC STATUS A RE-EXAMINATION OF ITS DIMENSIONS, W70-03837 06B

GRACE, R. A.
A MODEL FOR GENERATING SYNTHETIC SEQUENCES OF SHORT-TIME-INTERVAL RAINFALL DEPTHS, W70-03703 02B

GRAF, W.

THE MYXOBACTERIA TYPE QUOTIENT AS AN INDICATOR OF PUTROPHICATION FOR SURFACE WATERS (IN GERMAN), W70-03963

02H

GRAY, DON M. THE EFFECT OF SOIL HOISTURE ON INFILTRATION AS RELATED TO RUNOFF AND RECHARGE, \$w70-03884\$

GRPEN, G. E.

PORE PEPSUARE MEASUREMENTS IN THE FIELD AND IN THE
LABORATORY, PART J AND PART II,

W70-03797 08D

GREEN, R. W.
THE INFRA-RED DETERMINATION OF QUARTZ IN SEDIMENTS AND SEDIMENTARY ROCKS,
W70-03678
07B

GREMILLION, J.

THE TIDELANDS CONTROVERSY AND LOUISIANA'S EXPERIENCE IN THE DISPUTE,
W70-03688

06E

GRIMES, DONALD W.

PUNCTIONS FOR COTTON (GOSSYPIUM HIRSUTUM L.) PRODUCTION FROM
IRRIGATION AND NITROGEN PERFILIZATION VARIABLES II. YIELD
COMPONENTS AND QUALITY CHARACTERISTICS,

O21

FUNCTIONS FOR COTTON (GOSSYPIUM HIRSUTUM L.) PRODUCTION FROM IRRIGATION AND WITROGRN PERTILIZATION VARIABLES I. VIELD AND EVAPOTRANSPIRATION, W70-03806

GRIPPI, VINCENT
GRAVITY THICKENERS FOR ACTIVATED SLUDGE,
W70-03914
05D

HAIS, ALAN B. A TEN-UNIT WATER LEVEL SENSING AND RECORDING SYSTEM, wf0-03957 078

HALE, CARL W.
THE OPTIMALITY OF LOCAL SUBSIDIES IN REGIONAL DEVELOPMENT PROGRAMS,
W70-03838
06B

HALL, CHARLES E.
THE PROBLEMS ON TUNNEL EXPLORATION, W70-03792 ORE

HALL, WARREN A.

THE DYNAMIC PROGRAMMING APPROACH TO WATER-RESOURCES
DEVELOPMENT,
#70-03936

06B

HALL, W. A.
USE OF THE CRITICAL PERIOD IN RESERVOIR ANALYSTS,
W70-03655
044

HAMILTON, H. R. BIBLIOGRAPHY ON SOCIO-ECONOMIC ASPECTS OF WATER RESOURCES,

HAMMEL, D. J.
A HATHEMATICAL HODEL FOR PIT SLOPE STABILITY,
08E W70-03794

HAMMER, M. J.
DIALYSIS SEPARATION OF SEWAGE SLUDGE DIGESTION,
W70-03929 05D

HANKS, R. J.
MUMERICAL METHOD FOR ESTIMATING SIMULATAMEOUS FLOW OF WATER
AND SALT IN UNSATURATED SOILS,
W70-03851

02G

IMPILTRATION, REDISTRIBUTION, AND SUBSEQUENT EVAPORATION OF WATER FROM SOIL AS AFFECTED BY WETTING RATE AND HYSTERESIS, W70-03852

ELECTRICAL ANALOGUES AND DIGITAL COMPUTERS FOR ESTIMATING UNSATURATED WATER FLOW IN SOILS, W70-03882 02G

HANSEN, G.

ECOLOGY OF TEASTS FROM LAKE CHAMPLAIN,
W70-03962
05a

HANSHAW, BRUCE B.
RADIOCARBON DETERMINATIONS APPLIED TO GROUNDWATER SYDROLOGY,
W70-03890 02F

HART, J. S.
THE RELATION OF TEMPERATURE TO OXYGEN CONSUMPTION IN THE

HAUSER, L. G.
COOLING WATER SOURCES FOR POWER GENERATION,
W70-03727 05D

HAWKINS, D. B.
ENVIRONMENTAL TRITIUM STUDIES AT THE NATIONAL REACTOR
TESTING STATION,
05B

ATH, R. C.
BIBLIOGRAPHY OF THE GROUNDWATER RESOURCES OF NEW YORK
THROUGH 1967,
W70-03659 02F

HERPINDABL, ORRIS C.
IS RESOURCE ECONOMICS UNORTHODOX,
W70-03831 06B

HEWLETT, JOHN D.
DETERMINING AND MAPPING THE AVERAGE HYDROLOGIC RESPONSE OF EASTERN UNITED STATES, W70-04008 07C

06A

HICKS, J. R. LINEAR THEORY, W70-03993

HILLEL, DANIEL
RUNOFF INDUCEMENT IN ARID LANDS,
W70-03809

03B

HILLEL, D.

LABORATORY TESTS OF SPRAYABLE NATERIALS FOR RUNOFF INDUCEMENT ON A LOESSIAL SOIL,

N70-03804

02E

HIROKI, K.
STUDIES ON THE RESISTANCE OF MARINE BOTTOM INVERTRENATES TO OXIGEN-DEPICIENCY AND HYDROGEN SULFIDE, W70-03971

HITCHON, BRIAN
REGIONAL VARIATIONS OF BIVER WATER COMPOSITION RESULTING
FROM HALITE SOLUTION, MACKEMZIE RIVER DEALWAGE BASIN,

HOAR, W. S.

THE EFFECT OF DIETARY FAT ON THE HEAT TOLERANCE OF GOLDFISH (CARASSIUS AURATUS),
W70-03723

05C

HOLLBY, EDWARD R.
UNIFIED VIEW OF DIFFUSION AND DISPERSION,
W70-03729 088

HOOD, J. W.
HYDROLOGIC RECOMMAISSANCE OF SKULL VALLEY, TOOMLE COUNTY, UTAH, W70-03811

HOPKINS, C. B.
PHYSICOCHEMICAL TREATHENT OF WASTEWATER,
W70-03927 05D

HORTOBAGYI, T.
REPORT OF AN ALGAL BLOOM IN VIET-NAM,
W70-03969 05C

HSIUNG, KOU-YING TUBE CLARIFICATION PROCESS, OPERATING EXPERIENCES, W70-03911 05D

HUANG, C. J.
DEVELOPHENT OF MATHEMATICAL MODEL AND COMPUTER PROGRAM FOR

AUTHOR INDEX

HUA-LEE

OPTIBLEATION OF VERTICAL TUBE EVAPORATOR SALINE WATER PLANTS, W70-03665

HUFF, DALE D.
A NUMERICAL MODEL FOR THE HYDROLOGIC TRANSPORT OF RADIOACTIVE AEROSOLS FROM PRECIPITATION TO WATER SUPPLIES, 970-03698

HULL, WILLIAM J.

NATIONAL RIVERS AND HARBORS CONGRESS SUPPORTS A

COMPREHENSIVE WATER RESOURCES DEVELOPMENT PROGRAM,
W70-04043

06E

HUNGATE, P. P. EVAPORATIVE COOLING OF HEATED IRRIGATION WATER BY SPRINKLER APPLICATION, W70-03718

HUNTER, RALPH E.
EOLIAN MICRORIDGES ON MODERN BEACHES AND A POSSIBLE ANCIENT EXAMPLE,
W70-03661
02L

HUXHAM, S. H.
ON THE EXTREME VALUE DISTRIBUTION FOR DESCRIBING ANNUAL FLOOD SERIES,
W70-03854
02E

HUZZRN, C. S.
A PROPERTY OF THE RANGE OF PARTIAL SUMS,
W70-03701 07A

TAMANDI, CONSTANTIN
JET INDUCED CIRCULATION AND DIFFUSION,
W70-03734
08B

INGLES, O. G.
PRE-EQUILIBRIUM OBSERVATIONS ON THE RECONSTRUCTED FLAGSTAPF GULLY DAW,
W70-03782

IRION, GEORG

'SALT-RISCUITS' - A SPECIAL GROWTH STRUCTURE OF NACL IN SALT
SEDIMENTS OF THE TUZ GOLU ('SALT LAKE'), TURKEY,
W70-03671

02K

ISBIHARA, TOJIRO STOCHASTIC STUDY OF CHANNEL DISTRIBUTION IN RIVER BASINS, W70-03707 02E

ISHIHARA, YASHO
EVALUATION OF EXCREDANCE PROBABILITY OF FLOOD FOR FLOODPROTECTION WORKS IN RIVER,
W70-03886 044

TWASA, YOSHIAKI STOCHASTIC STUDY OF CHANNEL DISTRIBUTION IN RIVER BASINS, W70-03707 02E

JACKSON, C. J.

MANAGEMENT OF INDUSTRIAL EFFLUENT DISPOSAL IN BRITAIN, 970-03877 05D

JACKSON, DANIEL F.
ONONDAGA LAKE, NEW YORK--AN UNUSUAL ALGAL ENVIRONMENT,
W70-03974
05C

JAKOBS-HOGELTN, J. J. AVAILABILITY OF MUD PROSPHATES FOR THE GROWTH OF ALGAE, W70-03955 05C

JAMES, I. C., II
RELATIVE IMPORTANCE OF VARIABLES IN WATER RESOURCES
PLANNING,
W70-03656 06B

JENG, RAYMOND I.

EFFECTS OF INCONSISTENCY AND NON-HOMOGENEITY ON HYDROLOGIC
TIME SERIES,

W70-03905

02A

JOHNSON, L. E.
BIBLIOGRAPHY OF THE GROUNDWATER RESOURCES OF NEW YORK
THROUGH 1967,
R70-03659
02F

JOHNSON, NOTE M.
A WORKING HODEL FOR THE VARIATION IN STREAM WATER CHEMISTRY AT THE HUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE, W70-03867

JONES, ORDIE R.

DETERMINING SPECIFIC YIELD OF THE OGALLALA AQUIFER BY THE NEUTRON METHOD, W70-03871

KARLIK, JOHN
LARGE VOLUME - LONG DISTANCE PRESH WATER TRANSFERRAL AS AN ALTERNATE TO DESALINATION, W70-03810 06D

RATKO, ALBERG
RECLAIMED WASTEWATER FOR SANTEE RECREATIONAL LAKES, #70-03950 05D

KELLOGG, JAHES C. STRATEGY FOR MICHIGAN WATER RESOURCES MANAGEMENT A SYSTEMS APPROACH, W70-03944 06B RELSO, JOHN B. M.
DIEL AND SEASOWAL VARIATIONS IN PHYSIOCHEMICAL LIMNOLOGY,
SPEED RIVER, ONTARIO,
W70-03861

KEMPER, W. D.
INFILTRATION, REDISTRIBUTION, AND SUBSEQUENT EVAPORATION OF WATER FROM SOIL AS AFFECTED BY WETTING RATE AND HISTERESIS, W70-03852

KENNEDY, R. J.
A PEAK DISCHARGE RELATION FOR INTERMEDIATE DRAINAGE BASINS, W70-03855

KENNY, J. P.
BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES SUMMARY REPORT, W70-04004 05E

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCFAN DISPOSAL SITES VOLUME III - TECHNICAL ASPECTS OF PIPELINING OF WASTE MATERIALS, W70-04007

KHLOYEVA, TE. V.
CALCULATION OF MAXIMUM DISCHARGES OF CRIMEAN RIVERS
(RUSSIAN),
W70-03682 02E

KHOD'KOY, A. YE.
FORMATION AND GEOLOGICAL ROLE OF GROUNDWATERS,
W70-03679 02F

KIBLER, DAVID P.
EPPECTS OF SAMPLING INTERVAL, PERIODICITY, DEPENDENCE AND SKEWNESS ON EXTREME VALUES, 470-03910

KIRKLAND, E. V.
IMPROVED ANIONIC MEMBRANES FOR ELECTRODIALYSIS, W70-03666 03A

KLEIN, GERHARD
DESIGN AND COST OF ION-EXCHANGE SOFTEHING FOR A 50-HGD SEA-WATER EVAPORATION PLANT,
W70-03945
03A

KLEMENT, ALFRED W., JR.
HARINE RADIOECOLOGY,
W70-03956 05C

NNEESE, A. V.
PRODUCTION, CONSUMPTION, AND EXTERNALITIES, W70-03843
06B

KOLIPINSKI, MILTON C.

APPLICATIONS OF COLOR AERIAL PHOTOGRAPHY TO WATER RESOURCES
STUDIES,
P70-03869

KORVEN, R. C.
AN EVALUATION OF THREE COEFFICIENTS AS A MEASURE OF UNIFORMITY OF WATER APPLICATION BY SPRINKLERS, W70-03803 03F

KRUGER, PAUL
A NUMERICAL HODEL FOR THE HYDROLOGIC TRANSPORT OF
RADIOACTIVE AEROSOLS FROM PRECIPITATION TO WATER SUPPLIES,
W70-03698

KURPURST, P. J.
COMPARISON OF PILE LOAD-TEST-SKIN-PRICTION VALUES AND LABORATORY STRENGTH TESTS,
W70-03781 08D

LALIBERTE, G. E. SIMILITUDE FOR PARTIALLY SATURATED FLOW SYSTEMS, W70-03863 02G

LALOW, CLAUDE

GAMMA-RAY SPECTROSCOPY AS A TOOL FOR A RAPID INVESTIGATION
OF DETRIFIC CORES,
W70-03650
07B

LANG, J. G. PRE-EQUILIBRIUM OBSERVATIONS ON THE RECONSTRUCTED FLAGSTAFF GULLY DAM, w70-03782 08D

LARUE, M. E. FIELD MEASUREMENT AND USE OF SOIL-WATER PROPERTIES, W70-03675 02G

LEAP, CHARLES F.
SEDIMENT YIELDS FROM THE CENTRAL COLORADO SMOW ZONE, \$70-03821 2J

LEAMER, EDWARD E.
LOCATIONAL EQUILIBRIA,
W70-03839 06A

LEE, M. L.

DEVELOPMENT OF NATHEMATICAL HODEL AND COMPUTER PROGRAM FOR OPTIMIZATION OF VERTICAL TUBE EVAPORATOR SALIME WATER PLANTS,

W70-03665

03A

LEE, RONALD A.
RELIATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL
DISPERSING PRODUCTS,
W70-03913
05c

W70-03701 07A

LEVINSON, A. A.
REGIONAL VARIATIONS OF RIVER WATER COMPOSITION RESULTING
FROM HALITE SOLUTION, MACKENZIE RIVER DRAINAGE BASIN,
CANADA,

LIKENS, GENE P.
A MORKING MODEL FOR THE VARIATION IN STREAM WATER CHEMISTRY AT THE HUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE, W70-03667

LIND, ROBERT C.
BENEFIT-COST ANALYSIS A CRITERTON FOR SOCIAL INVESTMENT, W70-03999 06B

LIVELY, L. D.
PHOSPHATE REMOVAL AT FALTIMORE, MARYLAND, W70-03930 05D

LONG, WESLEY H.
AN EXAMINATION OF LINEAR HOMOGENETTY OF TRADE AND PRODUCTION FUNCTIONS IN COUNTY LEONTIEF MATRICES,
UT0-03824
06A

LUMB, ALAN M.
HYDROLOGIC EFFECTS OF RAINFALL AUGMENTATION,
W70-03931 02A

LUSZTIG, PETER
A COMPARATIVE ANALYSIS OF THE NET PRESENT VALUE AND THE
BENEFIT-COST RATTO AS MEASURES OF THE ECONOMIC DESIRABILITY
OF INVESTMENTS,
068

LT, TAO-CHI A GENERALIZATION OF THE CES PRODUCTION FUNCTION, W70-03829 06A

LYDA, S. D.
SOIL RESPIRATORY ACTIVITY AND ORGANIC MATTER DEPLETION IN AN ARID NEVADA SOIL, W70-03801 02G

LYFORD, PORRST P.
INFILTRATION PATES AS AFFECTED BY DESERT VEGETATION,
W70-03864 02G

MACCRIMMON, HUGH R.
DIRL AND SEASONAL VARIATIONS IN PHYSIOCHEMICAL LIMNOLOGY,
SPEED RIVER, ONTARIO,
W70-03861
02K

MACNISH, R. D.
BIBLIOGRAPHY OF THE GROUNDWATER RESOURCES OF NEW YORK
THROUGH 1967,
W70-03659

MAIRHOPER, J.
GROUNDWATER PLOW AND DIRECTION MEASUREMENT BY MEANS OF RADIOISOTOPES IN A SINGLE WELL,
M70-03892.
02P

MAKAB, KAMPL M.
DESIGN AND COST OF ION-EXCHANGE SOFTENING FOR A 50-MGD SEA-WATER EVAPORATION PLANT, 870-03945

MALONEY, F.
PLORIDA'S LAKES (PROBLEMS IN A WATER PARADISE),
W70-04013 06E

FLORTDA'S LAKES (WAVIGABILITY AND PUBLIC RIGHTS), W70-04014 $$\rm 0.6E$

FLORIDA'S LAKES (TESTS OF NAVIGABILITY), W70-04015 $$\rm{06E}$$

PLORIDA'S LAKES (RIGHTS IN LAKES), W70-04016

FLORIDA'S LAKES (RIGHTS ATTRIBUTABLE TO NAVIGABLE LAKES), W70-04017

PLORTDA'S LAKES (RIGHTS OF THE PUBLIC), W70-04018 06E

HARINE, I. WENDELL
THE USE OF A TRACER TEST TO VERIFY AN ESTIMATE OF THE
GROUNDWATER VELOCITY IN FRACTURED CRYSTALLINE ROCK AT THE
SAYANNAH RIVER PLANT NEAR AIKEN, SOUTH CAROLINA,
W70-03899

MARKOVIC, RADMILLO D.
DISCRIMINATING THE CHANGE IN MEANS OF HIDROLOGIC VARIABLES, #70-03898 044

MARKOVIC, RADMILO D.
A METHOD FOR STATISTICAL EVALUATION OF WEATHER MODIFICATION AT THE RIVER PLOW CONTROL LEVEL,
W70-03848
03B

HATALAS, N. C.

RELATIVE IMPORTANCE OF VARIABLES IN WATER RESOURCES
PLANNING,
W70-03656

06B

A PROPERTY OF THE RANGE OF PARTIAL SUMS,

MATELSKI, R. P. SOIL FACTORS IMPLUENCING PERCOLATION TEST PERFORMANCE, W70-03850 02G

MCDONALD, DONALD B.
FACTORS INFLUENCING ALGAL PRODUCTIVITY IN DEER CREEK RESERVOIR, UTAH, W70-03986 02H

MCGILCHRIST, C. A.
ON THE EXTREME VALUE DISTRIBUTION FOR DESCRIBING ANNUAL FLOOD SERIES, W70-03854

02E

MCHANUS, ELIZABETH A.
DISTRIBUTION, CHARACTERIZATION, AND NUTRITION OF MARINE
MICROGRAMISS FROM THE ALGAE POLYSIPHONIA LANOSA AND
ASCOPPYLLUM NODOSUM,
W70-03952
05C

HCWHORTER, D. B. SIMILITUDE FOR PARTIALLY SATURATED PLOW SYSTEMS, W70-03483 02G

MEDARDO, MOLINA EXTENSION OF RAINFALL RECORDS BY INTERSTATION CORRELATION, W70-03932 07A

MEEHAN, WILLIAM R.
SOME REFECTS OF SHADE COVER ON STREAM TEMPERATURE IN
SOUTHEAST ALASKA,
W70-03819
OSG

MELISENDA, IGNAZIO
ABOUT THE ANALYTICAL METHOD FOR THE COMPILATION OF THE WATER
BALANCE IN AGRICULTURE,
W70-03901
02D

MERCADO, A.

UPCONING OF FRESH WATER-SEA WATER INTERFACE BELOW PUMPING WELLS, FIELD STUDY,
W70-03677 04B

MERCIER, B. T.
NUMERICAL SIMULATION OF WITHDRAWAL PROF A STRATIFIED
RESERVOIR,
W70-03746 08B

MERRELL, JOHN C., JR.
RECLAIMED WASTEWATER FOR SANTEE RECREATIONAL LAKES, W70-03950 05D

MERRITT, W. P.
TECHNIQUES OF GROUNDWATER TRACING USING RADIONUCLIDES, W70-03896 02P

MEYERS, S. P.
BCOLOGY OF YEASTS FROM LAKE CHAMPLAIN,
W70-03962
05A

MIDGLEY, DESMOND C.
GENERALIZED DROUGHT SEQUENCE PROBABILITIES FOR STORAGE-DRAFT FREQUENCY ANALYSIS, W70-03904

02E

MILLER, CHRISTIAN S.
RESPARCH AND DEVELOPMENT ON LOW PRESSURE REVERSE OSMOSIS
MEMPRANES AND DESIGN OF A SMALL UNIT POR BRACKISH WATER,
W70-03667

MORRIS, DONALD A.

USP. OF CHEMICAL AND RADIOACTIVE TRACERS AT THE NATIONAL REACTOR TESTING STATION, IDAHO, W70-03893

MORTON, F. I.

POTENTIAL EVAPORATION AS A MANIFESTATION OF REGIONAL EVAPORATION, W70-03676

02D

EVAPORATION FROM LARGE DEEP LAKES, W70-03717 02

NOR, E.
DISTRIBUTION OF CHLORIDES IN AN IRRIGATED CITRUS OBCHARD, W70-03799 03C

HULLER, GERMAN

'SALT-BISCUITS' ~ A SPECIAL GROWTH STRUCTURE OF NACL IN SALT
SEDIMENTS OF THE TUZ GOLU ('SALT LAKE'), TURKEY,
W70-03671

02K

HUNNICH, K. O.
DOWNWARD MOVEMENT OF SOIL MOISTURE TRACED BY MEANS OF
HYDROGEN ISOTOPES,
W70-03689 02G

HURAD, J. L.
DIPLOGASTERID AND RHABDITID NEMATODES IN A WASTEWATER TREATHERT PLANT, W70-03925

HURDOCK, J. NEIL
GEOLOGY OF FLAHING GORGE DAM AND RESERVOIR,
W70-03791
08E

MUROTA, AKIRA SOME PROPOSALS OF THE STOCHASTIC METHOD OF FORECASTING FOR DEPOSITS IN RESERVOIRS, W70-03709 · 02J

HYERS, B. N.
COMPILATION OF RESULTS OF AQUIPER TESTS IN TEXAS,
W70-03660 02F

NAGAO, MASASHI EVALUATION OF EXCREDANCE PROBABILITY OF FLOOD FOR FLOOD-PROTECTION WORKS IN RIVER, W70-03886

NAKATANI, R. E.
BIOLOGICAL EFFECTS OF HANFORD HEAT ON COLUMBIA RIVER PISHES
A REVIFW,

NARODETSKAYA, R. YA.
RUNOFF VOLUME AND MAXIMUM DISCHARGES OF SPRING PLOODS
APPLIED TO THE UNSTUDIED RIVERS OF KALININGRADSK REGION
(RUSSIAN),
770-03683

NEESS, JOHN C.
BITROGEN METAPOLISM IN LAKES. I. MEASUREMENT OF NITHOGEN
FIXATION WITH N-15,
W70-03970
02H

NIELSPN, D. R. FIELD MEASUREMENT AND USE OF SOIL-WATER PROPERTIES, W70-03675 $$\rm 0.2G$

NIGHTINGALE, HARRY I.
STATISTICAL EVALUATION OF SALINITY AND NITRATE CONTENT AND TRENDS BENEATH URBAN AND AGRICULTURAL ARRA-FRESNO, CALIFORNIA, W70-03649

NIILER, P. P.
ON THERMALLY MAINTAINED CIRCULATION IN A CLOSED OCEAN BASIN, 970-03732
O2L

NTR, A.

DEVELOPMENT OF ISOTOPE METHODS APPLIED TO GROUNDWATER
HYDROLOGY,
W70-03891

NORUM, D. I.
THE EPPECT OF SOIL MOISTURE ON INPILTRATION AS RELATED TO RUNOPP AND RECHARGE,
W70-03884

OAKFORD, R. V.
MAXIMUM PROSPECTIVE VALUE CRITERION,
W70-03828 06B

OGATA, G.
ROOTZONE SALT PROFILES AND ALFALFA GROWTH AS INFLUENCED BY IRRIGATION WATER SALINITY AND LEACHING FRACTION, W70-03807

OLSON, R. A.
YIELD-PROTEIN RELATIONSHIPS IN WHEAT GRAIN, AS AFFECTED BY
NITROGEN AND WATER,
W70-03800
02G

OSTLUND, H. GOTF
HURPICANE TRITIUM I PRELIMINARY RESULTS ON HILDA 1964 AND
RETSY 1965,
W70-03693 02B

OUTCALT, SAM I.
WEATHER AND DIURNAL PROZEN SOIL STRUCTURE AT CHARLOTTESVILLE, VIRGINIA,
W70-03863
02C

OVERSTRPET, BOY
ON THE ROLES OF VERTICAL VELOCITY AND EDDY CONDUCTIVITY IN
HAINTAINING A THERMOCLINE,
W70-03730
02L

OWFNS, D. H. BIBLIOGRAPHY ON SOCIO-ECONOMIC ASPECTS OF WATER RESOURCES, \$70-03714

PALMER, M. D.
USER TRIALS OF A SUBMERSIBLE WATER QUALITY RECORDING METER, W70-03662

PAMA, R. P.
DISTRIBUTION OF CONCENTRATED LOADS ON ORTHOTROPIC BRIDGE
DPCKS,
W70-03798
08A

PANERO, ROBERT
LARGE VOLUME - LONG DISTANCE FRESH WATER TRANSPERRAL AS AN ALTERNATE TO DESALINATION, W70-03810 06D

PAPADOPOULOS, JOHN
DEVELOPMENT OF A PADIOISOTOPE GAGE FOR MONITORING SEDIMENT CONCENTRATION IN RIVERS AND STREAMS, U70-03687 07B

PATRICK, RUTH
A DISCUSSION OF NATURAL AND ABNORMAL DIATOM COMMUNITIES, W70-03966 05C

PATRIC, J. H. ELEVATION EFFECTS ON BAINFALL NEAR HOLLIS, ALASKA, W70-03820 02B PATTERSON, W. L.
COMMUNITIES OF OVER 1,000 POPULATION WITH MATER CONTAINING
IN EXCESS OF 1,000 PPM OF TOTAL DISSOLVED SOLIDS,
W70-03664

PAYNE, BRYAN R.
CONTRIBUTION OF ISOTOPE TECHNIQUES TO THE STUDY OF SOME
HYDROLOGICAL PROBLEMS,
470-03694
02A

PEREZ, ARMANDO I.
SIMULATION MODEL FOR FLOW AUGMENTATION COSTS,
W70-03940 05G

PETERSEN, G. W.
SOIL FACTORS INFLUENCING PERCOLATION TEST PERFORMANCE,
W70-03850 02G

PFEPFER, F. M.
PHOSPHATE REMOVAL AT BALTIMORE, MARYLAND, W70-03930 05D

PHINNEY, HARRY K.
PHYSIOLOGICAL ECOLOGY,
W70-03978 05C

PIERCE, R. S.
A WORKING MODEL FOR THE VARIATION IN STREAM WATER CHEMISTRY AT THE HUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE, W70-03867

PLAGER, S.
FLORIDA'S LAKES (PROBLEMS IN A WATER PARADISE),
W70-04013 06E

FLORIDA'S LAKES (NAVIGABILITY AND PUBLIC RIGHTS), W70-04014

FLORIDA'S LAKES (TESTS OF NAVIGABILITY), W70-04015

FLORIDA'S LAKES (RIGHTS IN LAKES), W70-04016 06E

FLORIDA'S LAKES (RIGHTS ATTRIBUTABLE TO NAVIGABLE LAKES), W70-04017 06E

FLORIDA'S LAKES (RIGHTS OF THE PUBLIC), W70-04018

FLORIDA'S LAKES (RIGHTS OF COMMERCIAL USERS), $\mbox{W70-04019}$

PONAT, A.
STUDIES ON THE RESISTANCE OF MARINE BOTTOM INVERTEERATES TO
OXYGEN-DEFICIENCY AND HYDROGEN SULFIDE,
W70-03971
05C

POON, C. P. C.
BIODEGRADABILITY AND TREATABILITY OF COMBINED NYLON AND
MUNICIPAL WASTES,
#70-03926
05D

POULOS, S.
ON THE EPPECTIVENESS OF SAND DRAINS,
W70-03784 08D

PREISS, KENNETH
DESIGN OF A NEUTRON SCATTERING WATER CONTENT GAGE FOR SOILS, W70-03686

PRIESING, C. P.
PHOSPHATE REMOVAL AT BALTIMORE, MARYLAND,
W70-03930 05D

PRIHAR, S. S.
VAPOR LOSSES THROUGH SOIL MULCH AT DIFFERENT WIND
VELOCITIES,
W70-03808
02G

PYATT, EDWIN E.
SIMULATION MODEL FOR FLOW AUGMENTATION COSTS, W70-03940 05G

QASHU, HASAN K.
INFILTRATION RATES AS APPECTED BY DESERT VEGETATION, W70-03664 02G

RAGAN, BOBERT M. THE DETERMINATION OF LOCAL INPLOWS ENTERING A CHANNEL, $\ensuremath{\text{W70-03699}}$

A TEN-UNIT WATER LEVEL SENSING AND RECORDING SYSTEM, W70-03857

RAMIG, R. E.
TIELD-PROTEIN RELATIONSHIPS IN WHEAT GRAIN, AS AFFECTED BY
NITROGEN AND WATER,
W70-03800 02G

RAPP, J. R.

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - IMDEX
TO GROUNDWATER STATIONS,
W70-73658

RATTRAY, HAURICE, JR.
ON THE ROLES OF VERTICAL VELOCITY AND EDDY CONDUCTIVITY IN
MAINTAINING A THERMOCLINE,
W70-03730 02L

RAWITZ, E.

LABORATORY TESTS OF SPRAYABLE MATERIALS FOR RUNOFF INDUCEMENT ON A LOESSIAL SOIL, W70-03804 02E

REDFIELD, ALFRED C.
APPLICATION OF DEUTERIUM ANALYSES TO THE HYDROLOGY OF THE LAKES OF THE GRAND COULEE, WASHINGTON, W70-03696

REDMAN, JOHN C.
COMMENT ON, 'THE WATERSHED AS AN ENTITY FOR PLANNING', W70-03988

REEDER, S. W.
REGIONAL VARIATIONS OF RIVER WATER COMPOSITION RESULTING FROM HALITE SOLUTION, MACKENZIE RIVER DRAINAGE BASIN, CANADA, 270, 2020.

REICH, BRIAN M.
PURPOSE AND PERFORMANCE OF PEAK PREDICTIONS,
W70-03887 04A

RPVANKAR, N. S.
GENERALIZED PRODUCTION FUNCTIONS,
W70-03833 069

RETNOLDS, JEREMIAH F.
COMPARISON STUDIES OF WINKLER VS. OXYGEN SENSOR,
W70-03876
05A

RICHARDS, B. G.
PRE-EDULLIRRIUM OBSERVATIONS ON THE RECONSTRUCTED FLAGSTAPP GULLY DAM,
970-03782

08D

RICHTER, CHARLES R. THE THRACT OF INDUSTRIAL LINKAGES ON GEOGRAPHIC ASSOCIATION, W70-03835 068

RIGGS, FLETCHER E.
THE WATERSHED AS AN ENTITY FOR PLANNING,
W70-03987 06B

ROBINSON, A. R.
THERMAL CIRCULATION ON A ROTATING SPHERE WITH APPLICATION
TO THE OCEANIC THERMOCLINF,
W70-03725
02L

ON THERMALLY MATHTAINED CIRCULATION IN A CLOSED OCEAN BASIN, W70-03732 02L

ROBINSON, G. D.
SOIL RESPIRATORY ACTIVITY AND ORGANIC MATTER DEPLETION IN AN ARID NEVADA SOIL,
W70-03801 02G

RODINA, A. G.
BACTERIAL POPULATION OF HUNIFIED LAKES (IN RUSSIAN),
W70-03948
02H

RODRIGUEZ-ITURBE, IGNACTO
ESTIMATION OF STATISTICAL PARAMETERS FOR ANNUAL RIVER FLOWS,
W70-03658
02F

RODRIQUEZ, IGNACIO SUNSPOTS AND HYDROLOGIC TIME SERIES, W70-03712 02A

ROBSLER, JOSEPH F.
TRICKLING PILTER MODEL DESIGN AND COST FACTORS, 970-03947 05D

ROETHER, W.
DOWNWARD MOYEMENT OF SOIL MOISTURE TRACED BY MEANS OF HYDROGEN ISOTOPES, W70-03689

ROSENBERG, LAURANCE C.
ON SUBSTDIES TO SPEED THE RATE AT WHICH TECHNOLOGIES ARE
DEVELOPPD,
W70-03830
06B

ROULEAU, W. T. WATER-HAMMER ATTENUATION WITH A TAPERED LINE, W70-03785 OBB

ROUSE, HUNTER
JET INDUCED CIRCULATION AND DIFFUSION,
W70-03734
088

ROXHOROUGH, T. F.

ROCK CUTTING RESEARCH FOR THE DESIGN AND OPERATION OF TUNNELLING MACHINES, W70-03793

ROZHDESTVENSKIY, A. V.
REDUCTION OF ARNUAL RIVER PLOWS TO LONGER PERIODS (RUSSIAN),
W70-03681

PUBLE, MEYER
RADIOCAPBON DETERMINATIONS APPLIED TO GROUNDWATER HYDROLOGY,
W70-03890 02P

RUTTNER, FRANZ
CONCEPTS OF PUTROPHICATION AND TROPHIC BIOLOGY,
W70-03959
02H

SALTER, I. O.
IMPROVED ANTONIC MEMBRANES FOR ELECTRODIALYSIS,
W70-03666
03A

SAMBORN, GENE
RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL
DISPERSING PRODUCTS,
970-03913
05C

SAXENA, O. P.
UPTAKE OF GLYCINE BY BLUE-GREEN ALGAE,
W70-03958 05C

SCALF, M. R.
PROSPRATE REMOVAL AT BALTIMORE, MARYLAMD, W70-03930 05D

SCHAARE, JOHN C. SINULATION MODEL FOR PLOW AUGHENTATION COSTS, W70-03940 05G

SCHLIEFER, C.
STUDIES ON THE RESISTANCE OF MARINE BOTTOM INVERTERATES TO OXYGEN-DEFICIENCY AND HYDROGEN SULFIDE, W70-03971 05C

SCHMALZ, B. L.
ENVIRONMENTAL TRITIUM STUDIES AT THE NATIONAL REACTOR
TESTING STATION,
W70-03898 05B

SCHRORAK, S.
UPCONING OF FRESH WATER-SEA WATER INTERFACE BELOW FURPING WELLS, FIELD STUDY, W70-03677 04B

SCHNEIDER, ARLAND D.

DETERMINING SPECIFIC YIELD OF THE OGALLALA AQUIFER BY THE
MEUTRON HEPHOD,
W70-03871

SCHNEIDER, WILLIAM J.
COLOR PHOTOGRAPHS FOR WATER RESOURCES STUDIES,
W70-03680 07B

APPLICATIONS OF COLOR AERIAL PHOTOGRAPHY TO WATER RESOURCES STUDIES,

SCHRAMM, MICHAEL
APPLICATIONS OF MONTE CARLO METHOD TO BESERVOIR DESIGN,
W70-03713
02A

SCHULTZ, VINCENT
MARINE RADIOECOLOGY,
W70-03956 05C

SCHWAB, BERNHARD
A COMPARATIVE ANALYSIS OF THE NET PRESENT VALUE AND TRE
BENEFIT-COST RATIO AS HEASURES OF THE ECONOMIC DESIRABILITY
OF INVESTMENTS,
W70-03825 . 06B

SCHWARTZ, A.

LARORATORY TESTS OF SPRAYABLE MATERIALS FOR RUMOFF INDUCEMENT ON A LOESSIAL SOIL,

170-03804

02E

SEBA, DOUGLAS B.
SURFACE SLICKS AS CONCENTRATORS OF PESTICIDES IN THE HARINE ENVIRONMENT, H70-03953

SELLERS, BACH
DEVELOPMENT OF A RADIOISOTOPE GAGE FOR HONITORING SEDIMENT
CONCENTRATION IN RIVERS AND STREAMS,
W70-03687
07B

SHAME, RICHARD M.

DETERMINATION OF OPTIMAL FLOOD PROTECTION LEVELS WITH SMALL EXCERDANCE PROBABILITIES,

W70-03653

06A

SHAPIRO, JOSEPH IROW IN MATURAL WATERS--ITS CHARACTERISTICS AND BIOLOGICAL AVAILABILITY AS DETERMINED WITH THE FERRIGRAM, W70-03954

SHARP, MAURICE L.
PIELD TESTS OF ALUMINUM ORTHOTROPIC BBIDGE DECK,
W70-03795 08G

SHAW, L. YO STOCHASTIC ASPECTS OF LAKE ORTARIO EVAPORATION, W70-03872 02D

SHERIDAN, RICHARD
ADMINISTRATIVE ARRANGEMENTS FOR WATER RESOURCES DEVELOPMENT
IN HONTANA,
W70-04044
06E

SHIH, C. S.
TEMPERATURE EFFECTS ON ENERGY OXYGEN REQUIREMENTS IN
BIOLOGICAL OXIDATION,
W70-03919
05D

SIDDIQUI, M. M.
APPLICATION OF RUBS TO HIDROLOGIC DROUGHTS,
W70-03909 02E

SILVER, R. S.
TECHNOLOGY OF SEA WATER DESALIMATION,
W70-03946 03A

STHON, HERBERT A. THEORIES OF DECISION-MAKING IN ECONOMICS AND BEHAVIORAL SCIENCE, W70-03991

STMPSON, HUGH C:
TECHNOLOGY OF SEA WATER DESALINATION,
W70-03946 03A

SLAUGHTER, CHARLES W.

SNOW ALBEDO MODIFICATION - A REVIEW OF LITERATURE, W70-03652 02C

SLOTTA, L. S.

NUMERICAL SIMULATION OF WITHDRAWAL FROM A STRATIFIED
BESERVOIR,

SMART, J. S.
COMPARISON OF SMART AND SCHEIDEGGER STREAM LENGTH HODELS,
W70-03862
02E

DISTRIBUTION OF INTERIOR LINK LENGTHS IN NATURAL CHANNEL NETWORKS,
W70-03878

SMITH, ROPERT TRICKLING FILTER MODEL DESIGN AND COST FACTORS, W70-03947 05D

SNOEK, P. E.
BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN
DISPOSAL SITES SUMMARY REPORT,
970-04004 05E

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES VOLUME II - CRITERIA FOR WASTE MANAGEMENT, 970-04006

SNOW, DAVID T.

ANTSOTROPIC PERMEABILITY OF PRACTURED MEDIA, W70-03870 02F

SOROLOY, B. L.

METHODS FOR THE DETERMINATION OF MAXIMUM SNOW RESERVES IN
THE RIVER BASINS OF THE CENTRAL CHERNOZEM (BLACK EARTH) BELT
(BUSSTAM),
W70-03684

SOUCEK, YLADMIR
CYCLIC FLUCTUATIONS OF VARIABILITY IN HYDROLOGIC PHENOMENA, #70-03711 02A

SPARR, ANTON E.
GRAVITY THICKFNERS FOR ACTIVATED SLUDGE,
W70-03914 05D

SPATZ, D. DEAN RESEARCH AND DEVELOPMENT ON LOW PRESSURE REVERSE OSMOSIS MEMBRANES AND DESIGN OF A SMALL UNIT FOR BRACKISH WATER, W70-03667

SPIEGEL, S. L.
ON TREPRALLY MAINTAINED CIRCULATION IN A CLOSED OCEAN BASIN, W70-03732 02L

STACK, V. T., JR.
TEMPERATURE EFFECTS ON ENERGY OXYGEN REQUIREMENTS IN
BIOLOGICAL OXIDATION,
W70-03919
05D

STAPLE, W. J.

COMPARISON OF COMPUTED AND MEASURED MOISTURE REDISTRIBUTION FOLLOWING INFILTRATION,
W70-03853

EVALUATION OF FLOW PARAMETERS, N70-03880 02G

STEINHARDT, R.
LABORATORY TESTS OF SPRAYABLE MATERIALS FOR RUNOFF INDUCEMENT ON A LOPSSIAL SOIL,
W70-03804 02F

STEPHPNS, G. C.
UPTAKE OF GLYCINE BY BLUE-GREEN ALGAE,
W70-03958
05C

STRWART, GORDON L.
FRACTIONATION OF TRITIUM AND DEUTERIUM IN SOIL WATER, W70-03897 02G

STONE, L. R. PIELD MEASUREMENT AND USE OF SOIL-WATER PROPERTIES, $\ensuremath{\text{W}70-03675}$

STORRS, PHILIP N.
BIOSTIMULATION AND TOXICITY CRITERIA AND APPLICATIONS IN DESIGN--PRESENT PRACTICE AND FUTURE POSSIBILITIES, W70-03982

STRAWN, KIRK GROWTH OF LARGEMOUTH BASS FRY AND VARIOUS TEMPERATURES, W70-03733

STRRET, ROBERT L.
COMPUTER STUDIES OF FINITE-AMPLITUDE WATER WAVES,
W70-04009 07C

STRELKOFF, THEODOR
COMPUTER STUDIES OF FINITE-AMPLITUDE WATER WAVES,

W70-04009

07C

STURZENHOPECKER, P.
THE MIXOBACTERIA TYPE QUOTIENT AS AN INDICATOR OF EUTROPHICATION FOR SURFACE WATERS (IN GERMAM), W70-03963

SUGAWARA, MASAMI ON THE FLUCTUATION OF WATER RESOURCES, W70-03705 02A

SURKAN, ALVIN J.
CONSTRAINED RANDOM WALK MEANDER GENERATION, W70-03866 02E

SZECHY, C. J.
TUNNELLING METHODS IN HUNGARY,
W70-03790 08A

TAKASAO, TAKUHA STOCHASTIC STUDY OF CHANNEL DISTRIBUTION IN RIVER BASINS, . W70-03707 02E

TAKHAR, HARMINDAR S.
TRENT BASIN STOCHASTICS,
W70-03902 02E

TAMERS, H. A.

RADIOCABBON AGES OF GROUNDWATER IN AN ARID ZONE UNCONFINED
AQUIFER,
W70-03895

TARANTINE, F. J.
WATER-HAMMER ATTENDATION WITH A TAPERED LINE,
W70-03785

TAYLOR, E. G.
UNIT SPACING OF HYDROELECTRIC MACHINES,
W70-03783 08C

TERNAN, G. L.
YIELD-PROTEIN RELATIONSHIPS IN WHEAT GRAIN, AS AFFECTED BY
HITROGEN AND WATER,
W70-03800
02G

TERRY, M. D.
NUMERICAL SIMULATION OF WITHDRAWAL FROM A STRATIFIED
RESERVOIR,
W70-03716

THATCHER, L. L. WATER TRACING IN THE HYDROLOGIC CYCLE, W70-03900 02A

THEEDE, H. STUDIES ON THE RESISTANCE OF MARINE BOTTOM INVERTEBRATES TO OXYGEN-DEFICIENCY AND HYDROGEN SULFIDE, H70-03971

THEILER, DONALD F.

EFFECTS OF PLOOD PROTECTION ON LAND USE IN THE COON CREEK,
WISCONSIN, WATERSHED,
W70-03654

O4A

THEUSEN, G. J.

MAXIMUM PROSPRCTIVE VALUE CRITERION;

W70-03828 06B

THIRDHURTHI, D. A BREAKTHROUGH IN THE TRACER STUDIES OF SEDIMENTATION TANKS, w70-03922 05D

THOMAS, WILLIAM H.
PHYTOPLANKTON MUTRIENT ENRICHMENT EXPERIMENTS OFF BAJA
CALIFORNIA AND IN THE EASTERN EQUATORIAL PACIFIC OCEAN,
W70-03949
05C

THOMPSON, T. L.
BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES SUMMARY REPORT, W70-04004 05E

TINNEY, E. BOY
WATER FOR WESTERN FEDERAL IRRIGATION PROJECTS,
W70-03996 03F

TLEINAT, BADAWI W.
DESIGN AND COST OF ION-EXCHANGE SOFTENING FOR A 50-HGD SEA-WATER EVAPORATION PLANT,
W70-03945
03A

TRACT, HARRY B.
RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEW OIL DISPERSING PRODUCTS, W70-03913 05c

TRIBUS, MYRON
THERMO-ECONOMICS OF SALINE WATER CONVERSION,
W70-03935
03A

TROCK, WARREN L.
INSTITUTIONAL FACTORS AFFECTING LAND AND WATER DEVELOPMENT,
LOWER RIO GRANDE VALLEY, TEXAS,
W70-03865
06B

TSANG, GEE
MOTION OF TWO DIMENSIONAL STARTING PLUME,
870-03731 088

TUCKER, J. H. ROOTZONE SALT PROFILES AND ALFALFA GROWTH AS IMPLUENCED BY

IRRIGATION	WATER	SALINITY	AND	LEACHING	FRACTION,
W70-03807)2G

TUCKER, RICHARD J.
USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIFS
CHAPPER III,
058

TUNZI, MILTON G. C-14 UPTAKE AS A SENSITIVE MEASURE OF THE GROWTH OF ALGAL CULTURES, W70-03983 05C

VACCARO, RALPH P.
THE RESPONSE OF NATURAL MICROBIAL POPULATIONS IN SPAWATER TO ORGANIC ENRICHMENT, W70-03967

VATOVA, B. S.

UPTAKE OF GLYCINE BY BLUE-GREEN ALGAE,

W70-03958

05C

VALUKONTC, G. YU.
FORMATION AND GEOLOGICAL ROLE OF GROUNDWATERS,
W70-03679 02F

VAMVAKIAS, JAHPS G.
TEMPERATURE RELATIONSHIP IN AEROBIC TREATMENT AND DISPOSAL
OF PULP AND PAPER WASTES,
W70-03720
05D

VAN KAN, JOSEPH CONSTRAINED RANDOM WALK MEANDER GENERATION, W70-03866 02E

VAUGHAN, P. R.
PORE PRESSURE MEASUREMENTS IN THE FIELD AND IN THE LABORATORY, PART I AND PART II,
W70-03797 ORD

VERBECK, G. J.
PIELD AND LARDHATORY STUDIES OF THE SULPHATE RESISTANCE ON CONCRETE,

VERDUIN, JACOB
PRINCIPLES OF PRIMARY PRODUCTIVITY PHOTOSYNTHESIS UNDER
COMPLETELY NATURAL CONDITIONS,
W70-03965
02K

VERMEDLEN, THEODORE
DESIGN AND COST OF ION-EXCHANGE SOFTENING FOR A 50-MGD SEA-WATER EVAPORATION PLANT,
W70-03945
03A

VIGANDER, SVEIN
ULTRA-LOW VELOCITY MRASHREMENT IN A STRATIFIED PESERVOIR BY ISOTOPIC CUPRENT METER,
970-036-97
02H

VITHA, OLDRICH
CYCLIC FLUCTUATIONS OF VARIABILITY IN HYDROLOGIC PHENOMENA,
W70-03711 02A

WADDELL, K. M.
HYDROLOGIC RECONNAISSANCE OF SKULL VALLEY, TOOELE COUNTY,
UTAH,
W70-03811

WADLETGH, CECIL H.
COMSERVING RESOURCES AND MAINTAINING A QUALITY ENVIRONMENT,
W70-03823
058

WALKOTTEN, W. J. ELEVATION EFFECTS ON RAINFALL NEAR HOLLIS, ALASKA, W70-03820 02B

WALTON, WILLIAM C. SELECTED ANALYTICAL METHODS FOR WELL AND AQUIFER EVALUATION, W70-03943

WASP, E. J.
BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES SUMMARY REPORT,
B70-04004 05E

WATT, W. P. A PEAK DISCHARGE RELATION FOR INTERMEDIATE DRAINAGE BASINS, W70-03855

WATT, W. C.
COMPARISON OF PILE LOAD-TEST-SKIN-PRICTION VALUES AND
LARGRATORY STRENGTH TESTS,
W70-03781
ORD

WEBER, W. J.
PHYSICOCHEMICAL TREATMENT OF WASTEWATER,
W70-03927 05D

WEEKS, W. F.
FRACTURE OF LAKE AND SEA ICE,
W70-03651 02

WELANDER, PIERRE
THERMAL CIRCULATION ON A ROTATING SPHERE WITH APPLICATION
TO THE OCPANIC THERMOCLINE,
#70-03725
02L

WPICH, ROBIN T.

THE USE OF REMOTE SENSING IN WATER RESOURCE MANAGEMENT, W70-03985

WESTFIELD, JAMES D.
ESTIMATION OF THE PARAMETERS OF GUMBEL'S THIRD ASYMPTOTIC DISTRIBUTION BY DIFFERENT METHODS, W70-03674 07C

WETZEL, ROBERT G.
EXCRETION OF DISSOLVED ORGANIC COMPOUNDS BY AQUATIC MACROPHYTES,
W70-03951
05C

WHITE, J. B.
STOCHASTIC ASPECTS OF BESERVOIR STORAGE,
W70-03706

WHITE, WILLIAM A.
EROSTON OF CIRQUES,
W70-03846

WHITLEY, JAMES R.
THERMAL DISCHARGE AND WATER QUALITY IN A 1,500-ACRF RESERVOIR,
W70-03845
05C

WILCOX, L. V.

NITRATE CONTENT OF THE UPPER RIO GRANDE AS INFLUENCED BY
NITROGEN FERTILIZATION OF ADJACENT IRRIGATED LANDS,
W70-03849

WILKENS, R. A.
BIBLIOGRAPHY OF THE GROUNDWATER RESOURCES OF NEW YORK
THROUGH 1967,
W70-03659
02F

WILKPN, P. H.
IMPROVED ANTONIC MEMBRANES FOR BLECTBODIALYSIS,
W70-03666 03A

WILLIS, JOE C.
AN ERROR FUNCTION DESCRIPTION OF THE VERTICAL SUSPENDED SEDIMENT DISTRIBUTION,
W70-03873
02J

UNIFICATION OF DATA ON SEDIMENT TRANSPORT IN PLUMES BY SIMILITUDE PRINCIPLES, W70-03874 02J

WINLAND, H. DALE
STABILITY OF CALCIUM CARBONATE POLYMORPHS IN WARM, SHALLOW
SEAWATER,
470-03672

WISER, EDWARD H.
AN ANALYSIS OF RUNS OF PRECIPITATION EVENTS,
W70-03702 07C

WITHEROW, J. L.
PHOSPHATE REMOVAL AT BALTIMORE, MARYLAND,
W70-03930 05D

WOELKE, CHARLES E.
RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL
DISPERSING PRODUCTS,
W70-03913
OSC

WOLF, M. A.

EVAPORATIVE COOLING OF HEATED IRRIGATION WATER BY SPEINKLER APPLICATION,

W70-03718

05D

WOODRUFF, JAMES F.
DETERMINING AND HAPPING THE AVERAGE HYDROLOGIC RESPONSE OF EASTERN UNITED STATES,
W70-04008
07C

WOOD, DOUGLAS
THE WATER SUPPLY SYSTEM UP TO A.D. 2001,
W70-03842 06C

WOOD, IAN R.
MOTION OF TWO DIMENSIONAL STARTING PLUME,
W70-03731 08B

WOOD, RICHARD
WASTEWATER RATES AND SERVICE CHARGES IN GREAT BRITAIN,
W70-03875
06E

WRIGHT, JOHN C.
PRODUCTIVITY OF RIVERS,
W70-03979 050

YAMADA, H.

FUNCTIONS FOR COTTON (GOSSYPIUM HIRSUTUM L.) PRODUCTION PROB

IRRIGATION AND NITROGEN FERTILIZATION VARIABLES I. VIELD

AND EVAPOTRANSPIRATION,

W70-03806 021

YARON, B.
DISTRIBUTION OF CHLORIDES IN AN IRRIGATED CITRUS ORCHARD,
W70-03799 03C

YEH, W. W-G.
USE OF THE CRITICAL PERIOD IN RESERVOIR ANALYSIS,
W70-03655
04A

YEUTTER, CLAYTON K.

WATER ADMINISTRATION - A SUGGESTED INSTITUTIONAL HODEL,
W70-04010

06E

R70-04011 06E

AUTHOR INDEX

W70-04012

YEVJEVICH, VUJICA SUNSPOTS AND HYDROLOGIC TIME SERIES, W70-03712 028

EFFECTS OF INCONSISTENCY AND NON-HOMOGENEITY ON HYDROLOGIC TIME SERIES, W70-03905 021

06E

EFFECTS OF SAMPLING INTERVAL, PERIODICITY, DEPENDENCE AND SKEWNESS ON EXTREME VALUES, W70-03910 02E

YEVJEVICH, V.
APPLICATION OF RUNS TO HYDROLOGIC DROUGHTS,
W70-03909 02E

ZELINKA, MILOS

RESULTS OF LIMNOLOGICAL INVESTIGATIONS ON THE VALLEY RESERVOIRS IN THE MORAVA RIVER BASIN,

W70-03715

02H

ZELLNER, A.
GENERALIZED PRODUCTION FUNCTIONS, W70-03833

ZEMAN, Z. P.
COMPARISON OF PILE LOAD-TEST-SKIN-FRICTION VALUES AND LABORATORY STRENGTH TESTS, W70-03781 08D

ZIEGLER, CHARLES A.

DEVELOPMENT OF A RADIOISOTOPE GAGE FOR MONITORING SEDIMENT
CONCENTRATION IN RIVERS AND STREAMS,
W70-03687

07B

06B

ZIMMERMANN, U.
DOWNWARD MOVEMENT OF SOIL MOISTURE TRACED BY MEANS OF
HYDROGEN ISOTOPES,
W70-03689
026



ORGANIZATIONAL INDEX

- ABROTT LABS., NORTH CHICAGO, TLL. DEPT. OF SANITARY ENGINEERING AND MICHIGAN UNIV., ANN ARBOR. A HETHOD FOR PREDICTING THE PEPETS OF LIGHT INTENSITY ON ALGAL GROWTH AND PHOSPHOROUS ASSIMILATION,
- OF NATURAL SCIENCES, PHILADELPHIA, PA. DEPT. OF LIMMOLOGY.
 A DISCUSSION OF NATURAL AND ABNORMAL DIATOR COMMUNITIES,
- AGRICULTURAL RESEARCH SERVICE, BELTSVILLE, ND. SOIL AND WATER CONSERVATION RESEARCH DIV.

 CONSERVING RESOURCES AND HAINTAINING A QUALITY ENVIRONMENT, W70-03823
- AGRICULTURAL RESEARCH SERVICE, BUSHLAND, TEX. SOUTHWESTERN GREAT PLAINS RESEARCH CENTER.

 DETERMINING SPECIFIC YIELD OF THE OGALLALA AQUIFER BY THE NEUTRON METHOD,

 W70-03871
- AGRICULTURAL RESEARCH SERVICE, FORT COLLINS, COLO. SOIL AND WATER CONSERVATION RESEARCH DIV.
 ELECTRICAL ANALOGUES AND DIGITAL COMPUTERS FOR ESTIMATING UNSATURATED WATER PLOW IN SOILS,
- AGRICULTURAL RESEARCH SERVICE, PRESNO, CALIF. GROUNDWATER RECHARGE FIELD STATION.

 STATISTICAL EVALUATION OF SALINITY AND NITRATE CONTENT AND TRENDS BENEATH URBAN AND AGRICULTURAL AREA-FRESNO, CALIFORNIA,
- AGRICULTURAL RESEARCH SERVICE, OXFORD, MISS. SEDIMENTATION
- LAB.
 AN ERROR FUNCTION DESCRIPTION OF THE VERTICAL SUSPENDED SEDIMPNT DISTRIBUTION, 02J
 - UNIFICATION OF DATA ON SEDIMENT TRANSPORT IN PLUMES BY SIMILITUDE PRINCIPLES, W70-03874 02J
- AGRICULTURAL RESEARCH SERVICE, RIVERSIDE, CALIF. SALINITY
- LAB.

 WITRATP CONTENT OF THE UPPER RIO GRANDE AS INFLUENCED BY NITROGEN PEPTILIZATION OF ADJACENT IRRIGATED LANDS, 05B
- AGRICULTURAL RESEARCH SERVICE, RIVERSIDE, CALIF. SOIL AND WATER CONSERVATION RESEARCH DIV. AND AGRICULTURAL RESEARCH SERVICE, RIVERSIDE, CALIF. SALINITY LAB. ROOTZONE SALT PROPILES AND ALFALFA GROWTH AS INPLUENCED BY IRRIGATION WATER SALINITY AND LEACHING PRACTION, W70-03807
- AKADEMIYA NAUK SSSR, LENINGRAD. ZOOLOGICHESKII INSTITUT. BACTERIAL POPULATION OF HUMIFIED LAKES (IN RUSSTAN), W70-03948 02H
- ALBERTA UNIV., EDMONTON. DEPT. OF CIVIL ENGINEERING. HORILE-RED FLUVIOLOGY, W70-03669 02J
- ALL SOULS COLL., OXPORD (ENGLAND). LINEAR THEORY, W70-03993
- ALUMINUM CO. OF AMERICA, NEW KENSINGTON, PA. ALCOA RESEARCH LABS.
 FIRLD TESTS OF ALUMINUM ORTHOTROPIC BRIDGE DECK, W70-03795 08G

064

- ARTZONA UNIV., TUCSON.
 POINT RAINPALL FREQUENCIPS IN CONVECTIVE STORMS,
 W70-03673 02B
 - A MATHEMATICAL MODEL FOR PIT SLOPE STABILITY, 970-03794
- INFILTRATION RATES AS APPECTED BY DESERT VEGETATION, W70-03864
- ARKANSAS UNIV., FAYETTEVILLE. DEPT. OF ZOOLOGY. GROWTH OF LARGEMOUTH BASS FRY AND VARIOUS TEMPERATURES, 970-03733
- ARMY TERRESTRIAL SCIENCES CENTER, HANOVER, N.H. FRACTURE OF LAKE AND SEA ICE, W70-03651 02C
 - SNOW ALBEDO MODIFICATION A REVIEW OF LITERATURE, W70-03652 02C
- ATOMIC ENERGY COMMISSION, IDAHO FALLS, IDAHO.
 ENVIRONMENTAL TRITIUM STUDIES AT THE NATIONAL REACTOR
 TESTING STATION,
 05B
- TOMIC ENERGY COMMISSION, WASHINGTON, D.C. BIOLOGY AND EDICINE DIV.

- THE APPLICATION OF ISOTOPES TO SOME PROBLEMS IN ATMOSPHERIC SCIENCES, W70-03690
- ATOMIC EMERGY OF CANADA LTD., CHALK RIVER (ONTARIO).
 ENVIRONMENTAL RESEARCH BRANCH.
 THE USE OF RADIOACTIVE TRACER GASES TO STUDY THE RATE OF
 EXCRANGE OF WATER VAPOR BETWEEN AIR AND NATURAL SUBPACES,
 W70-03695
- ATOMIC ENERGY OF CAWADA LTD., CHALK RIVER (ONTARIO).
 TECHNIQUES OF GROUNDWATER TRACING USING BADIONUCLIDES,
 #70-03896 02F
- ATOMIC EMERGY RESEARCH ESTABLISHMENT, DIDCOT (EMGLAND).
 DIFFUSIOPHORETIC AND THERMOPHORETIC EFFECTS ON PARTICULATE
 MATTER MEAR CONDENSING AND EVAPORATING WATER SURFACES,
 V70-03691 028
- BATTELLE MEMORIAL INST., COLUMBUS, OHIO.
 BIBLIOGRAPHY ON SOCIO-ECONOMIC ASPECTS OF WATER RESOURCES,
- BATTELLE MEMORIAL INST., RICHLAND, WASH. PACIFIC MOETHWEST EVAPORATIVE COOLING OF HEATED IRRIGATION WATER BY SPRINKLER 050
 - BIOLOGICAL EFFECTS OF HANFORD HEAT ON COLUMBIA RIVER FISHES A REVIEW, W70-03721
- BECHTEL CORP., SAN FRANCISCO, CALIF.
 BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN
 DISPOSAL SITES SUMMARY REPORT,
 W70-04004
 05E
 - BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES VOLUME I THE WASTE MANAGEMENT CONCEPT. W70-04005
 - BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES VOLUME II CRITERIA FOR WASTE MANAGEMENT, W70-04006
- BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES WOLUME III TECHNICAL ASPECTS OF PIPELINING OF WASTE MATERIALS, W70-04007 05E
- BLACK AND VEATCH, KANSAS CITY, MO.

 COMMUNITIES OF OVER 1,000 POPULATION HITH WATER CONTAINING
 IN EXCESS OF 1,000 PPM OF TOTAL DISSOLVED SOLIDS,
 W70-03664 07C
- BOWLING GREEN STATE UNIV., OHIO. DEPT. OF BIOLOGY.
 PRINCIPLES OF PRIMARY PRODUCTIVITY PHOTOSYMTHESIS UNDER
 COMPLETELY NATURAL CONDITIONS,
- BRITISH COLUMBIA UNIV., VANCOUVER.
 A COMPABATIVE ANALYSIS OF THE NET PRESENT VALUE AND THE BENEFIT-COST RATIO AS MEASURES OF THE ECONOMIC DESIBABILITY OF INVESTMENTS, W70-03825

 OGB
- BRITISH COLUMBIA UNIV., VANCOUVER. DEPT. OF ZOOLOGY.
 THE EFFECT OF DIETARY FAT ON THE HEAT TOLERANCE OF GOLDFISH
 (CARASSIUS AURATUS),
 W70-03723
- BRMO UNIV. (CZECHOSLOVAKIA).

 BESULTS OP LINNOLOGICAL INVESTIGATIONS ON THE VALLEY
 RESERVOIRS IN THE HORAVA RIVER BASIN,
 02H
- BROWN UNIV., PROVIDENCE, R.I.
 STABILITY OF CALCIUM CARBONATE POLYMORPHS IN WARM, SHALLOW
 SEAWATER,
 W70-03672
 02K
- BUREAU OF RECLAMATION, DENVER, COLO.

 APPLICATION OF PORE PRESSURE MEASUREMENTS TO SHEAR STRENGTH
 OF CORESIVE SOILS,
 - THE PROBLEMS ON TUNNEL EXPLORATION, W70-03792
- CALIFORNIA UNIV., BERKELEY.
 WATER RESOURCE DEVELOPMENT IN CALIFORNIA THE C
 EFFICIENCY OF LOCAL, STATE AND FEDERAL AGENCIES,
 04A THE COMPARATIVE
- CALIFORNIA UNIV., BERKELEY. HYDRAULIC LAB.
 COST, PRECISION, AND VALUE RELATIONSHIPS OF DATA COLLECTION
 AND DESIGN ACTIVITIES IN WATER DEVELOPMENT PLANNING,
- CALIFORNIA UNIV., BERKELEY. SEA WATER CONVERSION LAB.
 DESIGN AND COST OF ION-EXCHANGE SOFTENING FOR A 50-MGD SEA-WATER EVAPORATION PLANT,

CALIFORNIA UNIV., DAVIS. DEPT. OF WATER SCIENCE AND ENGINEERING AND CALIFORNIA UNIV., DAVIS. DEPT. OF AGRONOMY. PUNCTIONS FOR COTTON (GOSSPIUM HIRSUTUM L.) PRODUCTION FROM TRRIGATION AND NITROGEN FERTILIZATION VARIABLES II. YIELD COMPONENTS AND QUALITY CHARACTERISTICS, W70-03805

CALIFORNIA UNIV., DAVIS. DPPT. OF WATER SCIENCE AND ENGINEFRING. FUNCTIONS FOR COTTON (GOSSYPIUM HIRSUTUM L.) PRODUCTION PROMIREIGATION AND NITEGGEN PERTILIZATION VARIABLES I. YIELD AND EVAPOTEANSPIRATION, 2007.

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C-14 UPTAKF AS A SENSITIVE MEASURE OF THE GROWTH OF ALGAL

CALIFORNIA UNIV., IRVINE. DEPT. OF ORGANISMIC BIOLOGY AND GUJARAT UNIV., AHMADABAD (INDIA). BOTANY DIV. UPTAKE OF GLYCTNE BY BLUE-GREEN ALGAE, 970-03958

CALTFORNIA UNIV., LOS ANGELES.
USE OF THE CRITICAL PERIOD IN RESERVOIR ANALYSIS,
W70-03655

THE DYNAMIC PROGRAMMING APPROACH TO WATER-RESOURCES

CARNEGIE INST. OF TECH., PITTSBURGH, PA.
THEORIES OF DECISION-MAKING IN ECONOMICS AND BEHAVIORAL

CARNEGIE-MELLON UNIV., PITTSBURGH, PA.

DETERMINATION OF OPTIMAL FLOOD PROTECTION LEVELS WITH SHALL PXCPEDANCE PROPABILITIES, W70-03653

06a

CENTRE NATIONAL DE LA RECHERCHE SCIRNTIPIQUE, GIF-SUR-YVETTE (FRANCE). CENTRE DES FAIBLES RADIOACTIVITIES.

GAMMA-RAY SPECTROSCOPY AS A TOOL FOR A RAPID INVESTIGATION

CHICAGO UNIV., TLL. AND STATE UNIV. OF NEW YORK, BUFFALO.
GENERALIZED PRODUCTION FUNCTIONS,
W70-03833 06B

COLORADO SCHOOL OF MINES, GOLDEN.
ANISOTROPIC PERMPABILITY OF FRACTURED MEDIA,
02F

COLORADO STATF UNITA, FORT COLLINS. DEPT. OF CIVIL ENGINEEPING.
SUNSPOTS AND HYDROLOGIC TIME SERIES, W70-03712 02A

A METHOD FOR STATISTICAL EVALUATION OF WEATHER MODIFICATION AT THE RIVER FLOW CONTROL LEVEL, W70-03948 03B

DISCRIMINATING THE CHANGE IN MEANS OF HYDROLOGIC VARIABLES,

FFFECTS OF THEORYSISTENCY AND NON-HOHOGENEITY ON HYDROLOGIC TIME SERIES, W70-03905 02A

EFFECTS OF SAMPLING INTERVAL, PERIODICITY, DEPENDENCE AND SKEWNESS ON EXTREME VALUES, W70-03910

COLORADO STATE UNIV., PORT COLLINS. DEPT. OF SOIL SCIENCES AND UTAH STATE UNIV., LOGAN. DEPT. OF SOILS AND METEOROLOGY. NUMBERCAL METHOD FOR ESTIMATING SIMULATANEOUS FLOW OF WATER AND SALT IN UNSATURATED SOILS, W70-03851

COLORADO STATE UNITY., PORT COLLINS. DEPT. OF SOIL SCIENCE AND UTAH STATE UNITY., LOGAN. DEPT. OF SOILS AND METEOROLOGY. INFILTRATION, REDISTRIBUTION, AND SUBSROUENT EVAPORATION OF MATER PROM SCIL AS AFFECTED BY WETTING RATE AND HYSTERESIS, \$\frac{\psi}{470}-03852\$

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SOCIOECONOMIC STATUS A RE-EXAMINATION OF ITS DIMENSIONS,

#70-03837 068

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, MPLBOURNE (AUSTRALIA).
PRE-EQUILIBRIUM OBSERVATIONS ON THE RECONSTRUCTED PLAGSTAFF

CORPS OF ENGINFERS, ALBUQUEROUE, N. MEX.
FLOOD PLAIN INFORMATION, ARKANSAS RIVER, DODGE CITY, KANSAS.
W70-03668
04A

CORPS OF ENGINEERS, DETROIT, MICH.
FLOOD PLAIN IMPORMATION, LOOKINGGLASS RIVER, CLINTON COUNTY,
MICHIGAN.
WIO-03868

CORPS OF ENGINFERS, FOFT WORTH, TEX.

PLOOD PLAIN INFORMATION, ROSILLO CREEK, BEXAR COUNTY, TEXAS. W70-03647

CROWN ZELLERBACH CORP., CAMAS, WASH. MICRO-BIOLOGICAL RESPARCH.

PERMENTATION OF SPENT SULFITE LIQUOR FOR THE PRODUCTION OF

DARTHOUTH COLL., HANOYER, N.H.
RESPARCH AND DEVELOPMENT ON LOW PRESSURE REVERSE OSMOSIS
HEMBRANES AND DESIGN OF A SHALL UNIT FOR BRACKISH WATER,
03A

DARTHOUTH COLL., HANOYER, N.H. THAYER SCHOOL OF ENGINEERING. THERNO-ECONOMICS OF SALINE WATER CONVERSION,

DARTHOUTH COLL., HANOVER, B.H. YALE UNIV., NEW HAVES, CONN. GEOLOGICAL SURVEY, WASHINGTON, D.C. AND FOREST SERVICE (USDA), DUBHAM, N.H. A WORKING MODEL FOR THE VARIATION IN STREAM WATER CHEMISTRY AT THE HUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE, W70-03867

DECATUR SANITARY DISTRICT, ILL.
COMPARISON STUDIES OF WINKLER VS. OXYGEN SENSOR,
W70-03876
05A

DEPARTMENT OF AGRICULTURE, LETHBRIDGE (ALBERTA). RESEARCH SIMILITUDE FOR PARTIALLY SATURATED PLOW SYSTEMS,

DEPARTMENT OF AGRICULTURE, OTTAWA (ONTARIO). PLANT RESEARCH RELATIONSHIPS BETWEEN SOIL MOISTURE ACTUAL AND POTENTIAL

DEPARTMENT OF AGRICULTURE, OTTAWA (ONTARIO). SOIL RESEARCH

INST.
COMPARISON OF COMPUTED AND MEASURED HOISTURE REDISTRIBUTION POLLOWING INFILTRATION,
W70-03853
02G

EVALUATION OF PLOW PARAMETERS, W70-03880

DEPARTMENT OF AGRICULTURE, SWIFT CURRENT (SASKATCHEWAM).
RESEARCH STATION.
AN BYAUATION OF THREE COEFFICIENTS AS A MEASURE OF
UNIFORMITY OF WATER APPLICATION BY SPRINKLERS,

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DISTILLERS CO. LTD., LONDON (ENGLAND). DEPT. OF EFFLUENT AND BY-PRODUCTS.

HANAGERENT OF INDUSTRIAL EPFLUENT DISPOSAL IN BRITAIN, W70-03877

DUNDEE UNIV. (SCOTLAND).
DISTRIBUTION OF CONCENTRATED LOADS ON ORTHOTROPIC BRIDGE

ELECTRICITE DE FRANCE, CHATOU. CENTRE DE RECHERCHES ET D'ESSAIS. THE BAYES METHODS OF STATISTICAL HYDROLOGY (FRENCH), W70-03906

ENGINEERING-SCIENCE, INC., OAKLAND, CALIF.
BIOSTIMULATION AND TOXICITY CRITERIA AND APPLICATIONS IN
DESIGN--PRESENT PRACTICE AND FUTURE POSSIBILITIES,
N70-03982
06B

ENGLISH ELECTRIC CO. LTD., WHRTSTONE.
UNIT SPACING OF HYDROELECTRIC MACHINES,
W70-03783 OBC

ERLANGEN-NURENBERG UNIV. (WEST GERHANY). HYGIENISCH-BAKTERIOLOGISCHEN INSTITUT.

THE MYLOBACTERIA TIPE QUOTIENT AS AN INDICATOR OP EUTROPHICATION FOR SURFACE WATERS (IM GERMAN), W70-03963

ESSO RESEARCH AND ENGINEERING CO., FLORHAN PARK, N.J. ENVIRONMENTAL CONTROL. RESERVOIR SYSTEM DESIGN OPTIMIZATION, W70-03941 04A

PEDERAL WATER POLLUTION CONTROL ADMINISTRATION, CORVALUS, OREG.
SEDIMENT-WATER NUTRIENT INTERCHANGE,
W70-03980

PLORIDA UNIV., GAINESVILLE AND MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
SIMULATION MODEL FOR FLOW AUGMENTATION COSTS,

FOREST SERVICE (USDA) FORT COLLINS, COLO. ROCKY MOUNTAIN POREST AND RANGE EXPERIMENT STATION.
SEDIMENT YIELDS FROM THE CENTRAL COLORADO SNOW ZONE, W70-03824

FOREST SPRVICE (USDA) JUNEAU, ALASKA. PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION. ELEVATION EFFECTS ON RAINFALL NEAR HOLLIS, ALASKA,

FOREST SERVICE (USDA), CORVALLIS, OREG. PACIFIC NOPTHWEST POPEST AND PANGE EXPERIMENT STATION.

A BATTERY POWERED PROPORTIONAL STREAM WATER SAMPLER, W70-03856

FOREST SERVICE (USDA), JUNPAU, ALASKA. PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION. SOMP EPPECTS OF SHADE COVER ON STREAM TEMPERATURE IN SOUTHEAST ALASKA,

FRANKLIN COLL. OF ARTS AND SCIENCES, ATHENS, GA.
DETERMINING AND MAPPING THE AVERAGE HYDROLOGIC RESPONSE OF
EASTERN UNITED STATES,
W70-04008

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THE USE OF A TRACER TEST TO VERIFY AN ESTIMATE OF THE
GROUNCHATER VELOCITY IN PRACTURED CRYSTALLINE ROCK AT THE
SAVANNAH RIVER PLANT NEAR AIKEN, SOUTH CAROLINA,
W70-03899

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BIBLIOGRAPHY OF THE GROUNDWATER RESOURCES OF NEW YORK
THROUGH 1967,
W70-03659 02F

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COMPILATION OF RESULTS OF AQUIFER TESTS IN TEXAS, W70-03660 02F

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OCEANOGRAPHIC INSTITUTION, HASS.
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LAKES OF THE GRAND COULEE, WASHINGTON,
W70-03696

GEOLOGICAL SUPVEY, IOWA CITY, IOWA. AVAILABILITY OF GROUNDWATER IN WAYNE COUNTY, IOWA, #70-03879 02F

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GEOLOGY AND GROUNDWATER RESOURCES OF OCEAN COUNTY, NEW
JERSEY,
W70-03670
02F

GEOLOGICAL SURVEY, WASHINGTON, D.C.
COLOR PHOTOGRAPHS FOR WATER RESOURCES STUDIES,
W70-03680 07B

A PROPERTY OF THE RANGE OF PARTIAL SUMS, #70-03701

APPLICATIONS OF COLOR ARRIAL PHOTOGRAPHY TO WATER RESOURCES STUDIES, W70-03869 078

PRACTIONATION OF TRITIUM AND DEUTERIUM IN SOIL WATER, $\ensuremath{\text{W}}70-03897$

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CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO GROUNDWATER STATIONS, W70-03658

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RADIOCARBON DETERMINATIONS APPLIED TO GROUNDWATER HYDROLOGY, P70-03890

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GEORGIA STATE COLL., ATLANTA LOUISIANA STATE UNIV., BATON ROUGE STATE UNIV., COLL., PLATTSBURGH, N.Y. AND VERMONT UNIV., BURLINGTON.

ECOLOGY OF YEASTS FROM LAKE CHAMPLAIN, W70-03962 05A

GUELPH UNIV. (ONTARIO).
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SPEED RIVER, ONTARIO,
470-03861

GUELPH UNIV. (ONTARIO). DEPT. OF SOIL SCIENCE.
MECHANICS OF THE MOVEMENT OF MOISTURE AND CHEMICAL
SUBSTANCES IN SOILS,
W70-03881 02G

GULF RESEARCH AND DEVELOPMENT CO., PITTSBURGH, PA.
THERMO-OSMOSIS THROUGH COMPACTED SATURATED CLAY HEMERANES,
W70-03859

HARVARD UNIV., CAMBRIDGE, MASS.
ON THERMALLY MAINTAINED CIRCULATION IN A CLOSED OCEAN BASIN, W70-03732

ON THE EFFECTIVENESS OF SAND DRAINS, W70-03784 08D

OPERATIONS RESEARCH, W70-03992 06A

HARVARD UNIV., CAMBRIDGE, MASS. DEPT. OF ENGINEERING AND APPLIED PHYSICS.
A PRINCIPAL COMPONENT ANALYSIS OF SURFACE RUNOFF DATA FROM A NEW ZEALAND ALPINE WATERSHED,

HARVARD UNIV., CAMBRIDGE, MASS. AND STOCKHOLM INTERNATIONAL METEOROLOGICAL INST. (SWEDEN).
THERMAL CIRCULATION ON A ROTATING SPHERE WITH APPLICATION TO THE OCEANIC THERMOCLINE,
W70-03725
02L

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LABORATORY TESTS OF SPRAYABLE MATERIALS FOR RUNOFF INDUCEMENT ON A LOESSIAL SOIL,

028

HEIDELBERG UNIV. (WEST GERMANY). PHYSICS INST., C-14 LAB. DOWNWARD MOVEMENT OF SOIL MOISTURE TRACED BY MEANS OF HYDROGEN ISOTOPES, W70-03689 02G

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SEDIMENTS OF THE TUZ GOLU ("SALT LAKE"), TURKEY,
W70-03671

02K

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DEVELOPMENT OF MATHEMATICAL HODEL AND COMPUTER PROGRAM FOR OPTIMIZATION OF VERTICAL TUBE EVAPORATOR SALINE WATER PLANTS, W70-03665

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LARGE VOLUME - LONG DISTANCE FRESH WATER TRANSFERRAL AS AN ALTERNATE TO DESALINATION, W70-03810 06D

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REPORT OF AN ALGAL BLOOM IN VIET-NAH,
W70-03969 05C

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BEHAVIOR OF BUOYANT JET IN CALE FLUID,
W70-03724 08B

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COMPARISON OF SMART AND SCHEIDEGGER STREAM LENGTE MODELS,
W70-03862

CONSTRAINED RANDON WALK MEANDER GENERATION, 970-03866

DISTRIBUTION OF INTERIOR LINK LENGTHS IN NATURAL CHANNEL NETWORKS, W70-03878

ILLINOIS STATE WATER SURVEY DIV., URBANA.
SELECTED ANALYTICAL METHODS FOR WELL AND AQUIFER EVALUATION,
W70-03943 04B

ILLINOIS UNIV., URBANA.
DESIGN OF A NEUTRON SCATTERING WATER CONTENT GAGE FOR SOILS, W70-03686

RESEARCH ON HOUSEROLD BEHAVIOR, W70-03994 06B

ILLINOIS UNIV., URBANA. DEPT. OF CIVIL ENGINEERING.
UNIFIED VIEW OF DIFFUSION AND DISPERSION,
W70-03729 08B

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PORE PRESSURE MEASUREMENTS IN THE FIELD AND IN THE
LABORATORY, PART I AND PART II,
W70-03797 OBD

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BYTDENCE FOR EUTROPHICATION FROM REMAINS OF OBGANISHS IN
SEDIMENTS,

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BACTERIAL GROWTH RATE IN THE SEA DIRECT ANALYSIS BY
THYMIDINE AUTOPADIOGRAPHY.

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STATISTICAL CONSIDERATION IN RIVER MORPHOLOGY,
W70-03708
02E

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W70-03834 06R

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APPLICATIONS OF MONTE CARLO METHOD TO RESERVOIR DESIGN, 970-03713

OZA

THSTITUTO VENEZOLANO DE INVESTIGACIONES CIENTIFICAS, RADIOCARBON AGES OF GROUNDWATER IN AN ARID ZONE UNCONFINED

INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA (AUSTRIA).
CONTRIBUTION OF ISOTOPE TECHNIQUES TO THE STUDY OF SOME
HYDROLOGICAL PROFLEMS,

WATER THACING IN THE HYDROLOGIC CYCLE, W70-03900 02A

INTERNATIONAL JOINT COMMISSION-UNITED STATES AND CANADA. RX FOR AILING LAKES--A LOW PROSPHATE DIET, W70-03964 028

IONA UNIF., IONA CITY. INST. OF HYDRAULIC RESEARCH. JET INDUCED CIRCULATION AND DIPPUSION, W70-03734 08B

RENTUCKY UNIV., LEXINGTON.
COMMENT ON, "THE WATENSHED AS AN ENTITY FOR PLANNING", W70-03988
068

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KIEV HYDROMETROHOLOGICAL OBSERVATORY (USSR). CALCILATION OF MAXIMUM DISCHARGES OF CRIMEAN RIVERS (RUSSIAN), 870-03682

RNOULTON-PATLIFF-PRGLISH, FORT WORTH, TEX.

DRATNAGE MASTER PLAN FOR THE CITY OF PORT WORTH PUBLIC WORKS

DEPARTMENT, STORM DRAINAGE CRITERIA AND DESIGN MANUAL.

084

SECTION I, INTRODUCTION SECTION II, DETERMINATION OF DESIGN DISCHARGE SECTION IX, APPENDIX. 08A

SECTION III, FLOW IN GUTTERS SECTION IV, STORM DRAIN

SECTION V, PLOW IN STORM DRAINS AND THEIR APPURTERANCES SECTION VI, DESIGN OF CLOSED STORM DRAINAGE SYSTEM SECTION VII, DESIGN OF OPEN CHANNELS.

#70-03817

ORA

SECTION VIIT, DESIGN OF CULVERTS. W70-03818

ORA

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EVALUATION OF EXCREDANCE PROPABILITY OF FLOOD FOR PLOOD-PROTECTION WORKS IN RIVER, W70-03886 04A

LEWINGRAD STATE UNIV. (USSR).
FORMATION AND GEOLOGICAL ROLE OF GROUNDWATERS,
W70-03679 02F

LIVERPOOL UNIV. (ENGLAND). DEPT. OF OCEANOGRAPHY.
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SEDIMENTARY ROCKS,
W70-03678

LOS ANGRLES CITY PIRE DEPT., CALIF. WETTING AGENT TESTS. W70-03812

LIGHT WATER AND PROTEIN FOAM.

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DIPLOGASTERID AND RHABDITID NEMATODES IN A WASTEWATER TREATMENT PLANT, W70-03925 05D

MANCHESTER BUSINESS SCHOOL (ENGLAND).
THE WATER SUPPLY SYSTEM UP TO A.D. 2001,
#70-03842 06C

BANCHESTER UNIV. (ENGLAND). DEPT. OF ENGINEERING. TRENT BASIN STOCHASTICS, W70-03902 02E

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MARQUETTE UNIV., MILWAUKEE, WIS.

COPING WITH UNCERTAINTY IN THE MAKE OR BUY DECISION,
W70-03826

06B

MARYLAND UNIV., COLLEGE PARK.

THE DETERMINATION OF LOCAL INFLOWS ENTERING A CHANNEL, W70-03699

02E

TEN-UNIT WATER LEVEL SENSING AND RECORDING SYSTEM,

MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
A MODEL FOR GENERATING SYNTHETIC SEQUENCES OF SHORT-TIME-INTERVAL RAINFALL DEPTHS,

MASSACHUSETTS UNIV., AMHERST. DEPT. OF CIVIL ENGINEERING. INFILTRATION INDUCED SOIL INSTABILITIES, 870-03648 02G

HCGILL UNIV., MONTREAL (QUEBEC). DEPT. OF MICROBIOLOGY AND IMMUNOLOGY AND NEW BRUNSWICK UNIV., FREDERICTON. DEPT. OF BIOLOGY.
DISTRIBUTION, CHARACTERIZATION, AND NUTRITION OF MARINE HICROGRANISMS FROM THE ALGAE POLYSIPHONIA LABOSA AND ASCOPHYLLUM NODOSUS,

MIAMI UNIV., FLA. INST. OF MARINE SCIENCES.
SURFACE SLICKS AS CONCENTRATORS OF PESTICIDES IN THE MARINE
ENVIRONMENT,

HIAHI UNIY., FLA. INST. OF HABINE SCIENCE. HURRICAME TRITIUM I PRELIMINARY RESULTS ON HILDA 1964 AND BETSY 1965, W70-03693 02B

MICHIGAN STATE UNIV., HICKORY CORNERS. W. R. RELLOGG BIOLOGICAL STATION. EXCRETION OF DISSOLVED ORGANIC COMPOUNDS BY AQUATIC MACROPHYTES,

MICHIGAN UNIV., ANN ABBOR AND GEORGIA INST. OF TECH., ATLANTA.

ESTIMATION OF THE PARAMETERS OF GUMBEL'S THIRD ASYMPTOTIC DISTRIBUTION BY DIFFERENT METHODS,

870-03674

O7C

HICHIGAN UNIV., ANN ARBOR.
INVESTMENT RETURNS BEFORE AND AFTER TAX
W70-03827

LOCATIONAL EQUILIBRIA, W70-03839

COMMENT ON, "MESHING WATERSHED DEVELOPMENT WITH BIVER BASIN BYO-03989

HICHIGAN UNIV., ANN ARBOR. DEPT. OP CIVIL ENGINEERING AND FMC CORP., PRINCETON, N.J. PHYSICOCHEMICAL TREATMENT OF WASTEWATER, W70-03927

HIMISTRY OF AGRICULTURE, JERUSALEH (ISRABL). BYDROLOGICAL SERVICE AND WATER PLANNING FOR ISRAEL LTD., TEL-AVIV. UPCONING OF FRESH WATER-SEA WATER INTERFACE BELOW PUMPING WELLS, FIELD STUDY, W70-03677

HINRESOTA UNIV., HINNEAPOLIS. LIMNOLOGICAL RESEARCH CENTER.

IRON IN NATURAL WATERS -- ITS CHARACTERISTICS AND BIOLOGICAL AVAILABILITY AS DETERMINED WITH THE FERRIGRAM, W70-03954

02K

MISSOURI UNIV., COLUMBIA. DEPT. OF ZOOLOGY AND MISSOURI DEPT. OF CONSERVATION. FISHERIES DIV. THERMAL DISCHARGE AND WATER QUALITY IN A 1,500-ACRE

HONSAUTO RESEARCE CORP., DAYTON, OHIO.
IMPROVED AMIONIC MEMBRANES FOR ELECTRODIALISIS,
W70-03666 03A

HONTAWA STATE UNIV., BOZENAN.
ADBINISTRATIVE ARRANGEMENTS FOR WATER RESOURCES DEVELOPMENT
IN HONTAWA,
W70-04004
06E

HOHTANA STATE UNIV., BOZEHAN. CENTER FOR ENVIRONMENTAL STUDIES. PRODUCTIVITY OF RIVERS, W70-03979 050

HOSKOVSKATA SEL®SKOKHOZYAISTVENNAYA AKADEHIYA (USSE). THE ROLE OF PHOSPHATE-SOLUBLE BACTERIA IN THE ASSIMILATION

OF ROCK PHOSPHATE PHOSPHORUS UNDER CONDITIONS OF MONOBACTERIAL CULTURE (IN RUSSIAN),

NATIONAL ACADEMY OF SCIENCES, WASHINGTON, D.C. EUTROPHICATION CAUSES, CONSEQUENCES, CORRECTIVES. E70-03975 05C

NATIONAL AND UNIV. INST OF AGRICULTURE, REHOVOTH (ISRAEL).. VOLCANI INST. OF AGRICULTURE RESEARCH. RUNOFF INDUCEMENT IN ARID LANDS,

NATIONAL AND UNIV. INST. OF AGRICULTURE, REHOVOTH (ISRAEL). VOLCANI INST. OF AGRICULTURE RESPARCH. DISTRIBUTION OF CHLORIDES IN AN IRRIGATED CITRUS ORCHARD,

NATIONAL COUNCIL FOR STREAM IMPROVEMENT, BALTIMORE, MD.
TEMPERATURE RELATIONSHIP IN AEROBIC TREATMENT AND DISPOSAL
OF PULP AND PAPER WASTES,

NATIONAL REACTOR TESTING STATION, IDAHO FALLS, IDAHO.
USE OF CHEMICAL AND RADIOACTIVE TRACERS AT THE NATIONAL
BEACTOR TESTING STATION, IDAHO,
W70-03893

NERRASKA UNIV., LINCOLN.
VIELD-PROTEIN RELATIONSHIPS IN WHEAT GRAIN, AS AFFECTED BY
NITROGEN AND WATER,
W70-03800 02G

NEBRASKA UNIV., LINCOLN. DEPT. OF CIVIL ENGINEBRING. DIALYSIS SEPARATION OF SEWAGE SLUDGE DIGESTION, W70-03929

NEPTUNE MICROFLOC, INC., CORVALLIS, OREG.
TUBE CLARIFICATION PROCESS, OPERATING EXPERIENCES,
W70-03911 05D

NEVADA UNIV., RENO.
SOIL RESPIRATORY ACTIVITY AND ORGANIC MATTER DEPLETION IN AN ARID NEVADA SOIL,
W70-03801
02G

NEW SOUTH WALES UNIV., KRRSINGTON (AUSTRALIA).
ON THE PETREME VALUE DISTRIBUTION FOR DESCRIBING ANNUAL PLOOD SERIES, W70-03854

NEW YORK UNIV., BRONX. DEPT. OF METPOROLOGY AND OCEANOGRAPHY.
NOTES ON THE THEORY OF THE THERMOCLINE, W70-03726 02L

NPWCASTLE-UPON-TYNE UNIV. (FNGLAND).
BOCK CUTTING RESEARCH FOR THE DESIGN AND OPERATION OF
TUNNELLING NACHINES,
\$70-03793

OBE

NORGES TERNISKE ROEGSKOLE, TRONDHEIM. RIVER AND HARBOR LAB. DIFFUSION AND ENTRATHMENT IN TWO-LAYER FLOW, W70-03728

NORTH CAROLINA STATE UNIV., RALEIGH.
MINIMIZING NUCLEAR SOIL DENSYTY AND MOISTURE CONTENT GAGE
ERRORS,
470-03787
078

NORTH CAROLINA STATE UNIV., RALEIGH. DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING.
AN ANALYSIS OF RUNS OF PRECIPITATION EYENTS,

NORTH CAROLINA UNIV., CHAPEL HILL.
THE TMPACT OF INDUSTRIAL LINKAGES ON GEOGRAPHIC ASSOCIATION,

NORTH CAROLINA UNIV., CHAPEL HILL. DEPT. OF GEOLOGY. EROSTON OF CIRQUES, W70-03846 02J

NORTHEASTERN UNIV., BOSTON, MASS. DEPT. OF CIVIL ENGINERRING.
USR OF MATHEMATICAL MODELS IN WATER QUALITY CONTEOL STUDIES CHAPTER III,
W70-03933
05B

USES OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES CHAPTER IV, W70-03934 05B

NOVA SCOTTA TECHNICAL COLL., HALIFAX. DEPT. OF CIVIL ENGINEERING.
A BREAKTHROUGH IN THE TRACER STUDIES OF SEDIMENTATION TANKS, W70-03922

OFSTERREICHISCHE AKADEMIE DER WISSENSCHAFTEN, VIENNA. LUNZ BIOLOGICAL STATION. CONCEPTS OF EUTROPHICATION AND TROPHIC BIOLOGY, W70-03959 02H

OFFICE OF SALINE WATER, WASHINGTON, D.C. TEST AND EVALUATION OF SEA WATER DISTILLATION PLANTS, W70-03657 03A

OFFICE OF THE SECRETARY OF THE TREASURY, WASHINGTON, D.C. ON SUBSTDIES TO SPEED THE RATE AT WHICH TECHNOLOGIES ARE DEVELOPED,

W70-03830

OKLAHOMA STATE UNIV., STILLWATER AND IOWA STATE UNIV.,

AMES.
A GENERALIZATION OF THE CES PRODUCTION FUNCTION,
06 A

OKLAHOMA STATE UNIV., STILLWATER.

FIELD MEASUREMENT AND USE OF SOIL-WATER PROPERTIES,
W70-03675 02G

OKLAHOMA WATER RESOURCES RESEARCH INST., STILLWATER.
CARBON SOURCES IN ALGAL POPULATIONS AND ALGAL COMMUNITY

ORTARIO AGRICULTURAL COLL., GUELPH. SCHOOL OF AGRICULTURAL ENGINEERING.
AN ERROR MODEL FOR A SINGLE DISCHARGE MEASUREMENT, W70-03700

ERRORS IN DISCHARGE ESTIMATES ON MOUNTAIN STREAMS, 970-03889

ONTARIO WATER RESOURCES COMMISSION, TORONTO. GREAT LAKES SURVEY PROGRAM.
USER TRIALS OF A SUBMERSIBLE WATER QUALITY RECORDING METER, W70-03662

OREGON STATE UNIV., CORVALLIS, OREG.
NUMERICAL SIMULATION OF WITHDRAWAL PROM A STRATIFIED RESERVOIR,

OREGON STATE UNIV., CORVALLIS. DEPT. OF BOTANY. PHYSIOLOGICAL ECOLOGY, W70-03978 05C

OREGON STATE UNIV., CORVALLIS. DEPT. OF FISHERIES AND WILDLIFE.

THE CLASSIFICATION OF LAKES, W70-03984 02H

OSAKA UNIV. (JAPAN). DEPT. OF CIVIL ENGINEERING. SOME PROPOSALS OF THE STOCHASTIC METHOD OF FORECASTING FOR DEPOSITS IN RESERVOIRS,

OSLO UNIV. (NORWAY). INST. OF MARINE BIOLOGY.
REMOVAL OF SEWAGE NUTRIENTS BY ELECTROLYTIC TREATMENT,
W70-03972

PALERHO UNIV. (ITALY). ISTITUTO DI IDRAULICA.
ABOUT THE ANALYTICAL METHOD FOR THE COMPILATION OF THE WATER
BALANCE IN AGRICULTURE,
W70-03901 02D

PANAMETRICS, INC., WALTRAM, MASS.

DEVELOPMENT OF A RADIOISOTOPE GAGE FOR MONITORING SEDIMENT
CONCENTRATION IN RIVERS AND STREAMS,

07B

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK, PA. DEPT. OF CIVIL ENGINEERING AND COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING. PURPOSE AND PERFORMANCE OF PEAK PREDICTIONS, W70-03887

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.
AN EXAMINATION OF LINEAR HONOGENEITY OF TRADE AND PRODUCTION
FUNCTIONS IN COUNTY LEONTIEF HATRICES,
064

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF SOIL IENCE. SOIL FACTORS IMPLUENCING PERCOLATION TEST PERFORMANCE, W70-03850 02G

PHILIPPINES UNIV., MANILA.
ON INDEPENDENCE POSTULATES CONCERNING CHOICE,
W70-03832 06B

PORTLAND CEMENT ASSOCIATION, SKORIE, ILL.
FIELD AND LABORATORY STUDIES OF THE SULPHATE RESISTANCE ON
CONCRETE,
#70-03796

PUBLIC HEALTH SERVICE, SAN DIEGO, CALIF. SANTEE RECREATION PROJECT.

RECLAIMED WASTEWATER FOR SANTEE RECREATIONAL LAKES, 070-03950 05D

PUNJAB AGRICULTURAL UNIV., HISSAR (INDIA). DEPT. OF SOILS. VAPOR LOSSES THROUGH SOIL MULCH AT DIFFERENT WIND VELOCITIES, W70-03808 02G

QUEEN'S UNIV., KINGSTON (ONTARIO). A PEAK DISCHARGE RELATION FOR INTERNEDIATE DRAINAGE BASINS, W70-03855 02E

RESEARCH COUNCIL OF ALBERTA, EDMONTON CALGARY UNIV.

(ALBERTA) AND DEPT. OF EMERGY, MINES AND RESOURCES, CALGARY

(ALBERTA). INLAND WATERS BR.

REGIONAL VARIATIONS OF RIVER WATER COMPOSITION RESULTING FROM HALITE SOLUTION, NACKENZIE RIVER DRAINAGE BASIN, CANADA,

W70-03860 02K

RESOURCES FOR THE FUTURE, INC., WAS WASHINGTON, D.C. W70-03831

PRODUCTION, CONSUMPTION, AND EXTERNALITIES, W70-03843

RHODE ISLAND UNIY., KINGSTON. DEPT. OF CIVIL ENGINEERING. BIODEGRADABILITY AND TREATABILITY OF COMBINED NYLON AND MUNICIPAL WASTES, W70-03926 05D

RHODE ISLAND UNIV., KINGSTON. GRADUATE SCHOOL OF

OCEANOGRAPHY.
SUBMERGENCE EFFECTS ON A RHODE ISLAND BARRIER AND LAGOON AND IMPERENCES ON MIGRATION OF BARRIERS,
U70-03847.
02L

ROBERT A. TAPT WATER RESEARCH CENTER, CINCINNATI, OHIO. TRICKLING FILTER MODEL DESIGN AND COST PACTORS, 870-03947 05D

ROBERT S. KERR WATER RESEARCH CENTER, ADA, OKLA. PHOSPHATE REMOVAL AT BALTIMORE, MARYLAND, W70-03930 05D

RUTGERS - THE STATE UNIV., NEW BRUNSWICK, N.J. AND CORNELL UNIV., ITHACA, N.Y.
STOCHASTIC ASPECTS OF LAKE ONTARIO EVAPORATION,

SASKATCHEWAN UNIV., SASKATOON AND SIR GEORGE WILLIAMS UNIV., MONTERAL (OREBEC). COMPARTSON OF PILE LOAD-TEST-SKIN-PRICTION VALUES AND LABORATORY STRENGTH TESTS,

SASKATCHEWAN UNIV., SASKATOON. DEPT. OF AGRICULTURAL ENGINFERING.
THE EPPFCT OF SOIL MOTSTURE ON INFILTRATION AS RELATED TO RUNOPF AND RECHARGE,
W70-03884

SCRIPPS INSTITUTION OF OCEANOGRAPHY, LA JOLLA, CALIF. PHITOPLANKTON NUTRIENT ENRICHMENT EXPERIMENTS OFF BAJA CALIFORNIA AND IN THE EASTERN EQUATORIAL PACIFIC OCEAN, W70-03949 05C

STANFORD RESEARCH INST., MENLO PARK, CALIF.
THE USE OF PROOTE SENSING IN WATER RESOURCE MANAGEMENT, W70-03985

STANFORD UNIV., CALIF.
MAXIMUM PROSPECTIVE VALUE CRITERION,
W70-03828
06B

BRNEFIT-COST ANALYSIS A CRITERION FOR SOCIAL INVESTMENT, #70-03999 06B

STANFORD UNIV., CALIF. DEPT. OF CIVIL ENGINEERING.
A NUMERICAL MODEL FOR THE HYDROLOGIC TRANSPORT OF
BADIOACTIVE APPOSOLS FROM PRECIPITATION TO WATER SUPPLIES,
W70-03698

HYDROLOGIC EFFECTS OF RAINFALL AUGMENTATION, W70-03931 02A

EXTENSION OF PAINFALL RECORDS BY INTERSTATION CORRELATION, $\mathbf{W70-03932}$

STANFORD UNITAL, CALIF. DEPT. OF CIVIL ENGINEERING.
COMPUTER STUDIES OF PINITE-AMPLITUDE WATER WAVES,
W70-04009 07C

STATE HYDROLOGICAL INST., LEWINGRAD (USSR).
REDUCTION OF ANNUAL RIVER PLOWS TO LONGER PERIODS (RUSSIAN),
W70-03681

BETHODS FOR THE DETERMINATION OF MAXIMUM SNOW RESERVES IN THE RIVER BASINS OF THE CENTRAL CHERNOZEM (BLACK EARTH) BELT (RUSSIAN), 170-03684

STATE INST. FOR PLANNING RESERVOIR AND LAND IMPROVEMENT CONSTRUCTIONS, LENINGRAD (USSR).
RUNOFF VOLUME AND MAXIMUM DISCHARGES OF SPRING PLOODS APPLIED TO THE UNSTUDIED RIVERS OF KALININGRADSK REGION (RUSSTAN),
W70-03683

STOCKHOLH UNIV. (SWEDEN). INTERNATIONAL METEOPOLOGICAL INST.
THE ATMOSPHERIC TRANSPORT OF TRITIUM, #70-03692 02B

LARGE-SCALE UTTLIZATION OF TRITIUM IN HYDROLOGIC STUDIES, W70-03894

SYPACUSE UNIV., W. Y. DEPT. OF CIVIL ENGINEERING.
ONONDAGA LAKE, NEW YORK--AN UNUSUAL ALGAL ENVIRONMENT,
W70-03974

TECHNICAL UNITY., OF RUDAPEST (HUNGARY).
TUNNELLING METHODS IN HUNGARY,
W70-03790

TRCHNOLOGY PLANNING CENTRE, THC., ANN ARBOR, NICH.
STRATEGY FOR MICHIGAN WATER RESOURCES MANAGEMENT A SYSTEMS
APPPOACH,
W70-03944
06B

TENNESSEE VALLEY AUTHORITY, KNOXVILLE. DIV. OF AGRICULTURAL RELATIONS.

THE WATERSHED AS AN ENTITY FOR PLANNING, W70-03987 06B

TENNESSEE VALLEY AUTHORITY, NORRIS. ENGINEERING LAB.

ULTRA-LOW VELOCITI MEASUREMENT IN A STRATIFIED RESERVOIR BY
ISOTOPIC CURRENT METER,

TEXAS A AND M UNITY., COLLEGE STATION.
INSTITUTIONAL PACTORS AFFECTING LAND AND WATER DEVELOPMENT,
LOWER RIO GRANDE VALLEY, TEXAS,
06B

TEXAS UNIV., AUSTIN. DEPT. ENVIRONMENTAL HEALTH ENGINEERING.
ANTONIC AND MONIONIC SURFACTANT SORPTION AND DEGRADATION BY ALGAE CULTURES, W70-03928

TORONTO UNIV. (ONTARIO).

THE RELATION OF TEMPERATURE TO OXYGEN CONSUMPTION IN THE GOLDPISH,
W70-03722

05C

SOME POSSIBLE PHYSIOLOGICAL STRESSES INDUCED BY EUTROPHICATION, W70-03976 05C

UNIVERSIDAD NACIONAL DEL ZULIA, MARACAIBO (VENEZUELA).
ESTIMATION OF STATISTICAL PARAMETERS FOR ANNUAL RIVER PLOWS,
W70-03858
02E

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG (SOUTH APRICA). DEPT. OF HYDRAULIC ENGINEERING, GENERALIZED DROUGHT SEQUENCE PROPABILITIES POR STORAGE-DRAFT PREQUENCY ANALYSIS, W70-03904 02E

UTAH UNIV., SALT LAKE CITY. DEPT. OF ZOOLOGY AND IONA STATE UNIV., AMES. DEPT. OF SANITARY ENGINEERING. PACTORS IMPLUENCING ALGAL PRODUCTIVITY IN DEER CREEK RESERVOIR, UTAH,

VERMONT UNIV., BURLINGTON. DEPT. OF CIVIL ENGINEERING AND COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.

APPLICATION OF RUNS TO HYDROLOGIC DROUGHTS,

VIRGINIA UBIV., CHARLOTTESVILLE.
WEATHER AND DIURNAL PROZEN SOIL STRUCTURE AT
CHARLOTTESVILLE, VIRGINIA,
W70-03863
02C

WASHINGTON STATE UNIV., PULLMAN AND NEVADA OPERATIONS OFFICE (AFC), LAS VEGAS.

HARINE RADIOECOLOGY,

W70-03956 05C

WASHINGTON STATE UNIV., PULLMAN.
WATER FOR WESTERN FEDERAL IRRIGATION PROJECTS,
W70-03996 03P

WASHINGTON STATE UNIV., PULLHAN. DEPT. OF SANITARY ENGINEERING.
TRACE ELEMENT HEASUREMENTS IN THE AQUATIC ENVIRONMENT, W70-03981

WASHINGTON STATE WATER POLLUTION CONTROL COMMISSION, OLYMPIA. DEPT. OF PISHERIES.
RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL DISPERSING PRODUCTS, W70-03913

WASHINGTON UNIV., SEATTLE.
RETURNS TO SCALE AND COST CURVES,
W70-03844 060

WATER RESOURCES MANAGEMENT AND PUBLIC POLICY. W70-03995 068

THE ECONOMICS OF AGRICULTURAL WATER USE, $\pi 70{-}03998$

ECONOMIC ANALYSIS IN WATER QUALITY MANAGEMENT, W70-04000 06B

WASHINGTON UNIV., SEATTLE. DEPT. OF OCEANOGRAPHY.
ON THE ROLES OF VERTICAL VELOCITY AND EDDY CONDUCTIVITY IN
HAINTAINING A THERNOCLINE,
W70-03730 02L

WASHINGTON UNIV., ST LOUIS, MO.
AN EXTENSION OF THE GENERALIZED WEBER PROBLEM,
W70-03840 06A

WATER CONSERVANCY BOARD, PRAGUE (CZECHOSLOVAKIA).

CYCLIC FLUCTUATIONS OF VARIABILITY IN HYDROLOGIC PRENOMENA,
W70-03711

02A

WATERLOO UNIV. (ONTARIO). DEPT. OF MECHANICAL ENGINEERING AND NEW SOUTH WALES UNIV., KENSINGTON (AUSTRALIA). HOTION OF TWO DIMENSIONAL STARTING PLUME, W70-03731

WEIR (G. AND J.) LTD., GLASGOW (SCOTLAND). TECHNOLOGY OF SEA WATER DESALINATION, W70-03946 03A

WEIZHANN INST. OF SCIENCE, REHOVOTH (ISRAEL). DEPT. OF

ORGANIZATIONAL INDEX

- ISOTOPES.

 DEVPLOPMENT OF ISOTOPE METHODS APPLIED TO GROUNDWATER HYDROLOGY,
 W70-03891
- WELSH COLL. OF ADVANCED TECHNOLOGY, CARDIFF AND WATER RESEARCH ASSOCIATION, MEDHENHAM (ENGLAND).
 A MOSAIC TECHNIQUE FOR GENERATING THE DAILY PATTERN WITHIN A SYMTHERIC FLOW SEQUENCE,
 W70-03704
- WEST HERTPORDSHIRE MAIN DRAINAGE AUTHORITY, RICKMANSWORTH (EMCLAND).
 WASTEWATER RATES AND SERVICE CHARGES IN GREAT BRITAIN,
 W70-03875
- WEST VIRGINIA UNIV., MORGANTOWN.

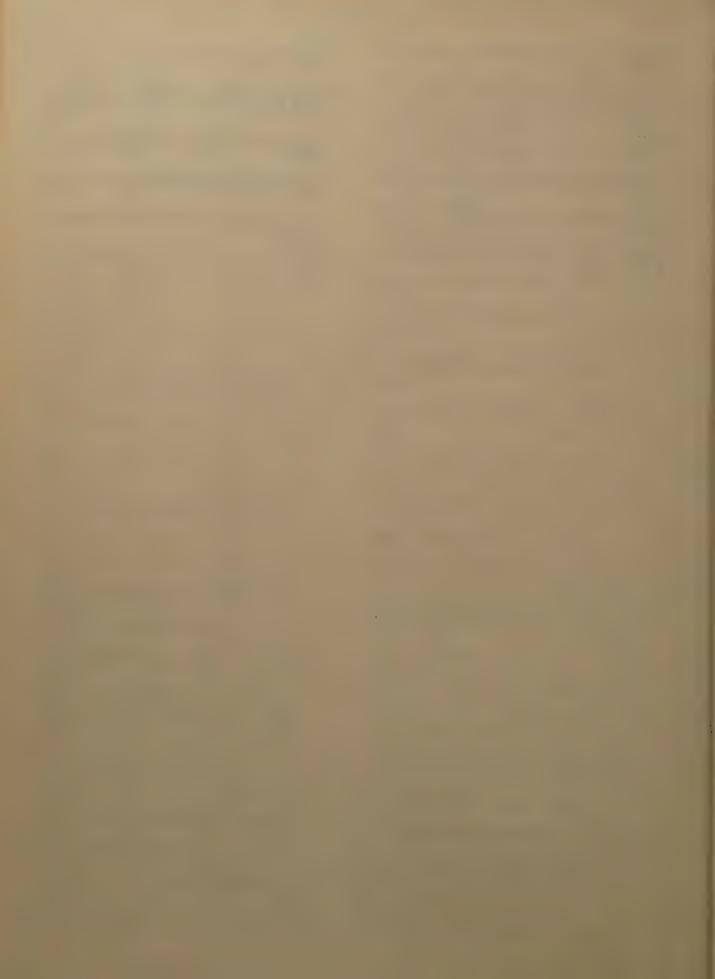
 THE OPTIMALITY OF LOCAL SUBSIDIES IN REGIONAL DEVELOPMENT PROGRAMS, 0.6P
- RESTINGHOUSE ELECTRIC CORP., EAST PITTSBURGH, PA. COOLING WATER SOURCES FOR POWER GENERATION, W70-03727 05D
- WESTON (ROY F.), INC., WEST CHESTER, PA.
 TEMPPRATURE PRECTS ON EMPRGY OXYGEN REQUIREMENTS IN
 BIOLOGICAL OXIDATION,
 W70-03919
 05D

- WISCONSIN BUREAU OF STATE PLANNING, MADISON.

 EPPECTS OF FLOOD PROTECTION ON LAND USE IN THE COON CREEK,
 WISCONSIN, WATERSHED,
 W70-03654
- WISCONSIN UNIV., MADISON. DEPT. OF ZOOLOGY AND PITTSBURGH UNIV., PA. DEPT. OF ZOOLOGICAL SCIENCES. NITROGEN METABOLISH IN LAKES. I. MEASUREMENT OF NITROGEN FIXATION WITH N-15,
- WISCONSIN UNIV., MADISON. WATER RESOURCES CENTER.
 AN ACTIVITY ANALYSIS OF NON-STRUCTURAL PLAIN MANAGEBENT
 ALTERNATIVES CHAPTER IV,
 W70-04003
 06F
- WOODS HOLE OCEANOGRAPHIC INSTITUTION, MASS.

 THE PERPONSE OF NATURAL MICROBIAL POPULATIONS IN SEAWATER TO ORGANIC ENRICHMENT,
 W70-03967

 05C
- YALE UNIY., NEW HAVEN, CONN. OSBORN MEMORIAL LABS.
 RELATION BETWEEN FILTERING RATE, TEMPERATURE, AND BODY SIZE
 IN FOUR SPECIES OF DAPHNIA,
 W70-03957
 05C
- YOUNGSTOWN STATE UNIV., OHIO CARNEGIE-MELLON UNIV., PITTSBURGH, PA. WATER-HAMMER ATTENUATION WITH A TAPERED LINE, WITO-03785 OAB



ACCESSION NUMBER INDEX

04A	W70-03647	08B	W70-03728	0	3B	W70-03809	02F	W70-03890
02G	W70-03648	08B	W70-03729		6D	W70-03810	07B	W70-03891
05B	W70-03649	02L	W70-03730		2F	W70-03811	02F	W70-03892
07B	W70-03650	08B 02L	W70-03731 W70-03732		3D 3D	W70-03812 W70-03813	02F 02A	W70-03893 W70-03894
02C	W70-03651 W70-03652	05C	W70-03733)8A	W70-03814	02F	W70-03895
06A	W70-03653	08B	W70-03734)8A	W70-03815	02F	W70-03896
04A	W70-03654	06E	W70-03735)8A	W70-03816	02G	W70-03897
04A	W70-03655	05G	W70-03736)8A)8A	W70-03817 W70-03818	05B 02F	W70-03898 W70-03899
06B 03A	W70-03656 W70-03657	05G 04A	W70-03737 W70-03738)5G	W70-03819	02F 02A	W70-03990
02F	W70-03658	06E	W70-03739)2B	W70-03820	02D	W70-03901
02F	W70-03659	06E	W70-03740		2J	W70-03821	02E	W70-03902
02F	W70-03660	04A	W70-03741)6E)5B	W70-03822 W70-03823	06E	W70-03903 W70-03904
02L 05A	W70-03661 W70-03662	04A 04A	W70-03742 W70-03743)6A	W70-03824	02E 02A	W70-03904
02E	W70-03663	04A	W70-03744)6B	W70-03825	02A	W70-03906
07C	W70-03664	06E	W70-03745)6B	W70-03826	04A	W70-03907
03A	W70-03665	03D	W70-03746)6B)6B	W70-03827 W70-03828	02E	W70-03908
03A	W70-03666 W70-03667	06E 05G	W70-03747 W70-03748)6A	W70-03829	02E 02E	W70-03909 W70-03910
03A 04A	W70-03668	06E	W70-03749)6B	W70-03830	05D	W70-03911
02J	W70-03669	06E	W70-03750		06B	W70-03831	04A	W70-03912
02F	W70-03670	06E	W70-03751		06B	W70-03832	05C	W70-03913
02K	W70-03671	06E	W70-03752		06B 06B	W70-03833 W70-03834	05D 06E	W70-03914 W70-03915
02K	W70-03672	06E 06E	W70-03753 W70-03754		06B	W70-03835	06E	W70-03916
02B 07C	W70-03673 W70-03674	06E	W70-03755		06B	W70-03836	04D	W70-03917
02G	W70-03675	04A	W70-03756		06B	W70-03837	04D	W70-03918
02D	W70-03676	04A	W70-03757		06B 06A	W70-03838 W70-03839	05D	W70-03919
04B	W70-03677	04A	W70-03758		06A	W70-03840	04A 05D	W70-03920 W70-03921
07B 02F	W70-03678 W70-03679	06E 04A	W70-03759 W70-03760		06D	W70-03841	05D	W70-03922
07B	W70-03680	04A	W70-03761		060	W70-03842	05C	W70-03923
02E	W70-03681	04A	W70-03762		06B	W70-03843	05D	W70-03925
02E	W70-03682	04A	W70-03763		06¢ 05¢	W70-03844 W70-03845	05D 05D	W70-03926 W70-03927
02E	W70-03683 W70-03684	06E 06E	W70-03764 W70-03765		02J	W70-03846	05D	W70-03928
02C 04A	W70-03685	04A	W70-03766		02L	W70-03847	05D	W70-03929
07B	W70-03686	05G	W70-03767		03B	W70-03848	05D	W70-03930
07B	W70-03687	05G	W70-03768		05B 02G	W70-03849 W70-03850	02A 07A	W70-03931 W70-03932
06E	W70-03688	05G 06C	W70-03769 W70-03770		02G	W70-03851	05B	W70-03933
02G 02B	W70-03689 W70-03690	06C	W70-03771		02G	W70-03852	05B	W70-03934
02B	W70-03691	04D	W70-03772		02G	W70-03853	03A	W70-03935
02B	W70-03692	06E	W70-03773		02E 02E	W70-03854 W70-03855	05G	W70-03936 W70-03938
02B	W70-03693	06E	W70-03774 W70-03775		07B	W70-03856	04B 05G	W70-03940
02A 02C	W70-03694 W70-03695	06E 06E	W70-03776		07B	W70-03857	04A	W70-03941
02K	W70-03696	06E	W70-03777		02E	W70-03858	04B	W70-03943
02H	W70-03697	06E	W70-03778		02G 02K	W70-03859 W70-03860	06B	W70-03944 W70-03945
02A	W70-03698	06E	W70-03779 W70-03780		02K	W70-03861	03A 03A	W70-03946
02E 02E	W70-03699 W70-03700	05G 08D	W70-03781		02E	W70-03862	05D	W70-03947
07A	W70-03701	08D	W70-03782		020	W70-03863	02H	W70-03948
07C	W70-03702	080	W70-03783		02G 06B	W70-03864 W70-03865	05C 05D	W70-03949 W70-03950
02B	W70-03703	08D	W70-03784		02E	W70-03866	05C	W70-03951
02A	W70-03704 W70-03705	08B 04A	W70-03785 W70-03786		02K	W70-03867	05C	W70-03952
02A 02A	W70-03706	07B	W70-03787		04A	W70-03868	05A	W70-03953
02E	W70-03707	07B	W70-03788		07B 02F	W70-03869 W70-03870	02K 05C	W70-03954 W70-03955
02E	W70-03708	04A	W70-03789		02F	W70-03871	05C	W70-03956
02J	W70-03709	08A 08E	W70-03790 W70-03791		02D	W70-03872	05C	W70-03957
07¢ 02A	W70-03710 W70-03711	08E	W70-03792		02J	W70-03873	05C	W70-03958
02A	W70-03712	08E	W70-03793		02J	W70-03874 W70-03875	02H	W70-03959 W70-03960
02A	W70-03713	08E	W70-03794		06E 05A	W70-03876	05C 05A	W70-03962
06B	W70-03714	08G	W70-03795 W70-03796		05D	W70-03877	02H	W70-03963
02H	W70-03715	08F 08D	W70-03797		02E	W70-03878	02H	W70-03964
08B 02D	W70-03716 W70-03717	08A	W70-03798		02F	W70-03879	02K	W70-03965
05D	W70-03718	030	W70-03799		02G 02G	W70-03880 W70-03881	05¢ 05¢	W70-03966 W70-03967
06E	W70-03719	02G	W70-03800		02G	W70-03882	05C	W70-03968
05D	W70-03720	02G 04A	W70-03801 W70-03802		02G	W70-03883	05C	W70-03969
05C	W70-03721 W70-03722	03F	W70-03803		02G	W70-03884	02H	W70-03970
05C 05C	W70-03723	02E	W70-03804		02D	W70-03885	05C 05D	W70-03971 W70-03972
08B	W70-03724	021	W70-03805		04A 04A	W70-03886 W70-03887	05D 05C	W70-03972
02L	W70-03725	021	W70-03806 W70-03807		04A	W70-03888	05C	W70-03974
02L 05D	W70-03726 W70-03727	02G 02G	W70-03808		02A	W70-03889	05C	W70-03975
090	110-05121	020						53

ACCESSION NUMBER INDEX

05¢	W70-03976	06A	W70-03993	06E	W70-04011	06E	W70-04028
02H	W70-03977	06B	W70-03994	06E	W70-04012	03D	W70-04029
05C	W70-03978	06B	W70-03995	06E	W70-04013	03D	W70-04030
05C	W70-03979	03F	W70-03996	06E	W70-04014	06E	W70-04031
02H	W70-03980	04A	W70-03997	06E	W70-04015	05G	W70-04032
02H	W70-03981	06B	W70-03998	06E	W70-04016	05G	W70-04033
06B	W70-03982	06B	W70-03999	06E	W70-04017	05G	W70-04034
05C	W70-03983	06B	W70-04000	06E	W70-04018	03D	W70-04035
02H	W70-03984	05B	W70-04001	06E	W70-04019	03D	W70-04035
07B	W70-03985	06F	W70-04003	04A	W70-04020	04A	W70-04037
02H	W70-03986	05E	W70-04004	04A	W70-04021	04A	W70-04038
06B	W70-03987	05E	W70-04005	06E	W70-04022	06E	W70-04039
06B	W70-03988	05E	W70-04006	06E	W70-04023	05G	W70-04040
06B	W70-03989	05E	W70-04007	06E	W70-04024	03D	W70-04040
06B	W70-03990	07C	W70-04008	05G	W70-04025	06E	W70-04041
06B	W70-03991	07¢	W70-04009	06E	W70-04026	06E	W70-04042
06A	W70-03992	06E	W70-04010	06E	W70-04027	06E	W70-04043

ABSTRACT SOURCES

Sai	irce		
301	irce	Accession Numbers	Total
A.	Centers of Competence		
	U.S. Geological Survey - Hydrology	W70-03647 03684 03686 03687 03689 03714 03845 03902 03904 03906 03908 03910 03645 03646	135
		04005 04007	
	Rutgers - The State University - Water Resources Economics	W70-03823 03844 03987 04000	26
	University of Texas - Wastewater Treatment	W70-03913 03914 03921 03930 03911, 03916, 03919	14
	Bureau of Reclamation - Engineering Works	W70-03781 03785 03787 03788 03790 03798	16
	University of Florida - Eastern U.S. Water Law	W70-03736 03780 04010 04043 03685, 03688, 03719, 03735, 03786, 03789, 03802, 03822,	95
		03903, 03907, 03912, 03915, 03916, 03917, 03918, 03920	
	University of Arizona - Arid Land Water Resources	W70-03799 03801 03803 03811	12
	University of Chicago - Metropolitan Water Resources Management	W70-03812 03818	7
	Vanderbilt University - Thermal Pollution	W70-03715 03718 03720 03734	19
	University of Wisconsin - Eutrophication	W70-03948 03986 04001	40
	Cornell University - Policy Models for Water Resources Systems	W70-03933 03947 04003	16
0 th	ers:		
	U.S. Forest Service	W70-03819 03821	3
	Stanford University	W70-03931 03932	2,,
	Federal Water Pollution Control Administration (Bechtel Corporation)	W70-04004	1
	University of Georgia	W70-04008	1
	California Water Resources Center	W70-04009	1
	Montana Water Resources Research Center	W70-04044	1

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Subject Fields

NATURE OF WATER

WATER CYCLE

WATER SUPPLY AUGMENTATION AND CONSERVATION

WATER QUANTITY MANAGEMENT

WATER QUALITY MANAGEMENT AND PROTECTION

WATER RESOURCES PLANNING

RESOURCES DATA

ENGINEERING WORKS

MANPOWER, GRANTS, AND FACILITIES

SCIENTIFIC AND TECHNICAL INFORMATION

DOSTAGE AND FEES PAID

LIBRARY RATE PRINTED MATTER

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES

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